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LOWER WILLAMETTE GROUP

PORTLAND HARBOR RI/FS

STORMWATER LOADING CALCULATION METHODS

FINAL

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January 31, 2011

Prepared for
The Lower Willamette Group

Prepared by
Anchor QEA, LLC

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REGION 10
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Portland Harbor RI/FS Stormwater Loading Calculation Methods Report Final January 31, 2011

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LIST OF ACRONYMS

AFT	Abiotic Fate and Transport Model
BES	City of Portland Bureau of Environmental Services
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FSR	Field Sampling Report
FWM	Food Web Model
GOF	goodness-of-fit
HST	Hydrodynamic and Sediment Transport Model
IC	Indicator chemical
LWG	Lower Willamette Group
NPDES	National Pollutant Discharge Elimination System
OC	organic carbon
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PD	percent difference
PRG	Preliminary Remediation Goals
QA	quality assurance
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
ROS	regression on order statistics
RPD	relative percent difference
SCRA	Site Characterization and Risk Assessment
Site	Portland Harbor Superfund Site
SSR	Stormwater Sampling Rationale
SVOC	semivolatile organic compound
SWQA	National Stormwater Quality
TEQ	toxic equivalent quotient
TOC	total organic carbon
TSS	total suspended solids
UCL	Upper Confidence Limit
UPL	Upper Prediction Limit

1.0 INTRODUCTION

This document presents the methods for conducting stormwater loading estimate calculations using stormwater and sediment trap data collected as part of the Remedial Investigation and Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). The detailed steps taken to calculate stormwater loading estimates are described below. This document also presents the complete stormwater loading estimate results, as well as a brief discussion of the associated uncertainty.

These data were collected in accordance with the Round 3A Stormwater Field Sampling Plan and Addendum (FSP; Anchor and Integral 2007a and c) and its companion document, the Round 3A Stormwater Sampling Rationale (SSR) (Anchor and Integral 2007b) and analyzed in accordance with the Quality Assurance Project Plan Addendum 8 (QAPP Addendum 8, Integral 2007). The field sampling activities are described in detail in the Round 3A Upland Stormwater Sampling Field Sampling Report (FSR; Anchor and Integral 2007d) and the FSR Addendum (Anchor and Integral 2008). Stormwater data collected by the Port of Portland at Terminal 4 were collected in accordance with the above reports. Composite water data were collected during a total of 15 storm events, with each of the 32 outfalls (including Terminal 4) sampled an average of three times. Sediment traps were left in place for 3 to 7 months during two separate sampling periods. Measurable sediment trap data were collected at 28 outfalls. Due to the limited time span of sampling and the known variability of stormwater, these data should be considered to represent a "snapshot" of stormwater entering the Site during the sampling period. One additional site (GE Decommissioning) was sampled (composite water only) by GE during the same timeframe. This site is located within the City of Portland OF-17 stormwater basin, and data collected from this site only represent a small portion of the stormwater runoff associated with OF-17. Results from the GE investigation (AMEC 2007a and b, AMEC 2008a, b, and c) are also included in the overall Lower Willamette Group (LWG) stormwater data set. Additionally, in early 2008, the City of Portland collected three additional composite water samples to supplement the residential data set; these samples are included as well.

1.1 BACKGROUND AND CONTEXT

In November 2006, the U.S. Environmental Protection Agency (EPA) and LWG determined that stormwater data were needed to complete the RI and FS, and that such data would need to be collected during the 2006/2007 wet weather season to fit within the overall RI/FS project schedule. They convened a Stormwater Technical Team, which included representatives from EPA, Oregon Department of Environmental Quality (DEQ), and LWG, to develop the framework for a sampling plan. The sampling framework described in the FSP was developed by the Stormwater Technical Team and is based on an EPA memorandum dated December 13, 2006 (Koch et al. 2006). This framework was discussed and approved by Portland Harbor managers from EPA, DEQ, the Tribes, and LWG on December 20, 2006.

The Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and selected those described in the framework and elaborated in the SSR, based on 1) the ability to meet the objectives for data use (see Section 2.1) as agreed to by the Portland Harbor managers; and 2) practicability in terms of schedule, cost, and feasibility.

The sampling framework was initially designed to complete stormwater data collection by the end of the 2006/2007 wet weather season (i.e., May/June 2007). However, the Stormwater Technical Team reviewed sample completeness information after the end of the 2006/2007 season (first round) and identified several substantial data needs that still existed to meet the originally intended FSP and SSR objectives. A second round of sampling was conducted in the late portion of 2007 and the early portion of 2008 (per the FSP Addendum) in order to collect as much data as possible while still staying within the constraints of the RI/FS schedule. Per the EPA letter dated March 24, 2008, and its attached table (included in Appendix B), it was determined that the data collection activities associated with the FSP Addendum have been completed and there are no remaining stormwater data gaps for the purposes of the RI/FS.

The data analysis and handling procedures detailed below were initially presented in the Draft Stormwater Loading Methods Report (Anchor 2008) and have been refined through a series of discussions and recommendations from EPA and the Stormwater Technical Team. Most recently, these steps were discussed by the Stormwater Technical Team and EPA during the Stormwater Loading Check-in Meeting on February 27, 2009 (See Appendix A). Additional comments were provided by EPA on April 29, 2009. This document is consistent with decisions discussed during Stormwater Technical Team calls, the Check-in Meeting, as well as the written comments and recommendations provided by EPA thereafter.

1.2 PURPOSE OF DOCUMENT

The purpose of this document is to outline the framework for analyzing the composite stormwater and sediment trap data and calculating stormwater loads to the Site, and present stormwater loading estimate results for use in the RI and FS.

2.0 OBJECTIVE OF LOADING EVALUATION

The objective of the loading evaluation is to provide data to understand the fate and transport of upland discharges through stormwater to the Lower Willamette River within the Site. These stormwater loading evaluation results will be input into estimation tools and models (discussed in Section 2.2) to further develop the understanding of the relative magnitude of stormwater impacts to the Site. The results were presented in summary form for the median flow year in the Draft RI and discussed in the context of sources, loading, and fate and transport. This report presents the loading evaluation results for a range of flow years and this information will ultimately support the evaluation of remedial alternatives in the Site FS.

2.1 RI/FS STORMWATER SAMPLING OBJECTIVES

The objectives of the RI/FS stormwater sampling program as discussed by the Stormwater Technical Team and accepted by EPA are to:

- Understand the stormwater contribution to in-river fish tissue chemical burdens.
- Determine the potential for recontamination of sediment (after cleanup) from stormwater inputs.

2.1.1 Stormwater Contribution to Fish Tissue Burdens

Surface water chemicals have the potential to contribute to fish tissue burdens (and related risks) at the Site. The relative importance of various sources of surface water chemicals is not well understood. The sources to the water column from resuspension of sediment versus other waterborne sources (such as stormwater and upstream contributions) are needed to understand the potential for recontamination.

Thus, this report develops stormwater loading estimates to estimate the relative contribution of stormwater chemicals to fish tissue burdens. Other potential sources to the water column and fish tissue that will be investigated by the LWG include contributions from upstream surface water, direct atmospheric deposition to the river, over-water discharge, in-river sediments (through porewater exchange and sediment resuspension), riverbank erosion, and groundwater discharge to the river. Additionally, it is important that the in-river modeling tools used (discussed in Section 2.2.) for the Site accurately predict the contribution from the water column relative to other potential sources of tissue chemical burdens.

2.1.2 Stormwater Contribution to Recontamination Potential

Contaminated
Stormwater solids discharges have the potential to contribute to recontamination of sediments. The potential for recontamination via stormwater solids will be assessed at an FS-appropriate level[1] of detail to understand the general extent and need for source

[1] FS-level of detail refers to the fact that the FS will address issues at the level of detail needed to develop and evaluate preferred remedial alternatives. This is opposed to, for example, a design level of detail, which may require smaller scale, greater frequency, or other types of more detailed information.

controls that will minimize the potential for recontamination of the appropriate sediment cleanup remedies determined in the FS. More detailed evaluation of recontamination potential will be conducted during remedial design.

To predict whether remediated sediments would recontaminate to levels above the cleanup levels that will eventually be set for the Site, estimates of stormwater loads are needed for input into estimation tools and models described in Section 2.2. These stormwater loading estimates must be on a spatial scale consistent with those estimation tools and models.

2.2 RI/FS USES OF STORMWATER DATA

Several evaluation and modeling tools will use the stormwater loading estimates to meet the aforementioned objectives. One of these tools is described in the Draft Chemical Fate and Transport Model Development and Data Gaps Identification Report (Anchor et al. 2007). The fate and transport model includes three independent models collectively known as the "Hybrid Model:"

- Hydrodynamic and Sediment Transport (HST) Model: This model has been developed by the LWG to describe the movement of water and sediments around the Site. This model has been developed in several phases during the project. It was originally developed by WEST Consultants (2006), has recently been revised and recalibrated by Anchor QEA and accepted by EPA in revised form for use in the project, subject to several additional EPA requested model testing procedures being carried out
- The Fate and Transport Model: Originally, the Abiotic Fate and Transport (AFT) Model, a model developed by EPA in coordination with DEQ to describe chemical movement and distribution within abiotic environmental media at the Site (Hope 2006), was proposed for use during the project. In late 2009, EPA and LWG agreed to use QEAFate, an alternative model in place of AFT. Either model can be used to predict changes in water column and sediment concentrations of contaminants based on the principles of mass balance.
- Food Web Model (FWM): This model was developed by Windward Environmental for the LWG in collaboration with EPA and partner agencies to describe the movement of chemicals from water and sediment into biota and through the aquatic food web (Integral et al. 2007).

The Hybrid Model requires estimates of the chemical mass load (e.g., kilograms per month) from each type of chemical source (e.g., in-river sediment, stormwater, groundwater, upstream, etc.) for each of the model-defined cells of the river. This report presents the methods for estimating these model input loads for stormwater.

The Hybrid Model was not run to support the source and fate and transport evaluation in the draft RI. Instead, the draft RI contains a separate empirical evaluation of source, fate, and transport that relies directly on the stormwater data and loading estimates without intermediary use of the Hybrid Model. The findings from the Hybrid modeling efforts will be incorporated into Sections 6 and 10 of the final RI Report.

Results from the Hybrid Model (including stormwater loading estimates) will be used in the FS to understand the potential for recontamination and evaluate the long-term outcome of various sediment remediation alternatives evaluated in the FS.

The stormwater loading estimates developed using the methods described in this report are not in any way intended for use in evaluating stormwater source controls at individual upland sites. These data were collected to address stormwater loading at the scale of the Hybrid Model in-river cells; certain assumptions such as application of the measured loading rate to the entire site will need to be further evaluated at a smaller spatial scale as part of the recontamination evaluation. LWG is evaluating the use of the Hybrid Model or other analytical approaches at a smaller spatial scale (i.e., AOPC-scale) in the FS.

3.0 CHEMICAL LISTS FOR STORMWATER LOADING ESTIMATES

Before stormwater loading estimates can be made, the list of chemicals relevant to those estimates must be developed. Different chemical lists, as detailed in Table 3-1, will be defined for the various RI/FS purposes of:

- RI empirical source, fate, and transport evaluations[2]
- FS Hybrid Model runs for recontamination and long-term alternatives evaluations

A stormwater loading indicator chemical (IC) list was developed as part of the RI. This list of target chemicals for stormwater loading calculations was further discussed in Section 6.0 of draft RI report and consists of the combined IC lists for in-river sediment, surface water, and biota. This list was generated from the overall list of ICs for the loading, fate, and transport developed in consultation with EPA, and reflects data availability and relevance of the chemical to the loading mechanism. This list is inclusive of all analytes to be run by the Hybrid Model (discussed below). This report focuses on the list of analytes to be run by the Hybrid Model, and summary tables presented in this report include these analytes only.

3.1 SAMPLED CHEMICALS

The priority order and list of chemicals analyzed was presented in the stormwater FSP and varies somewhat for each sampling type among locations. The list of chemicals analyzed at each sampling location is shown in Table 3-2. Table 3-2 includes seven sampling locations associated with the Port of Portland's Terminal 4 recontamination study. As discussed in the SSR, the overall sampling approach for the Terminal 4 sampling was similar to that described in the FSP, and the data generated will be used consistently with those generated at other locations. Additionally, the priority of analytes for sediment traps was changed in some cases per decisions made by the Stormwater Technical Team and EPA due to limited sample volume; the data presented in Table 3-3 reflects those changes. The rationale for variation in chemical lists for sampling locations and the rationale for other specific methods for each sample type are described in the SSR and FSR.

3.2 CHEMICAL LISTS FOR RI/FS PURPOSES

Because of the logistical difficulty of running numerous chemicals through the Hybrid Model, the RI empirical loading, fate, and transport evaluation list has been further reduced to a list of chemicals for use in the model runs. Consideration was given to include primary risk drivers, as well as select chemicals of other types, which cross a range of geochemical behavioral characteristics.

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[2] Similar to the Round 2 Report, the RI will contain a section that describes the loading, fate, and transport of chemicals around the Site based on the empirical date collected in Rounds 1 through 3 of project sampling. This section will not rely on Hybrid Model estimates of long- term fate and transport processes, but will look at the stormwater loading estimates calculated in this report in comparison to loading rates from other sources.

In summary and as shown in Table 3-1, lists of chemicals were developed for stormwater loading estimates as follows:

- RI empirical loading, fate, and transport evaluations – largest list (presented in the RI only)
- FS Hybrid Model runs for recontamination, and alternative long-term effectiveness evaluation

All of the preliminary stormwater loading calculation steps discussed in this report will include the entire list of "RI empirical loading, fate, and transport evaluations" chemicals. However, in this report, loads will only be presented for chemicals required for the Hybrid Model. Loads generated for RI purposes are presented in the RI report.

4.0 OVERALL LOADING METHODS

This section provides an overview of the loading methods and data handling, and Sections 5 and 6 provide additional details for stormwater and trap solids-based loads, respectively. In general, to estimate stormwater loads, a chemical concentration in stormwater and the volume of stormwater discharge (i.e., time-integrated flows) must be known. These terms can be either directly measured or estimated through indirect means (e.g., runoff modeling of stormwater volumes).

As stated above, the purpose of the RI/FS stormwater sampling effort was to provide data for evaluating the potential risk and sediment recontamination from stormwater discharges to the river. Because the scope of this data collection effort was to provide sufficient data for an RI/FS-level evaluation of stormwater loads and contributions to potential in-river risk and recontamination issues for the Site, it was not necessary to collect direct measurements from every stormwater discharge to the Site.

Instead, the stormwater sampling location rationale was designed using a commonly used approach of applying "Representative" estimates of stormwater chemical concentrations for various land use types (Scheuler 1987). This land-use-based chemical load modeling approach is used to estimate loads across the entire Site. Chemical loading models use site characteristics (e.g., land use and percent impervious area) and land-use-specific loading rates to estimate overall loading into the receiving waters. This approach has been modified to better fit the unique data needs and land use characteristics of the Site, as well as the practical constraints for this sampling effort.

A flow chart explaining the process for calculating stormwater loads is shown in Figure 4-1.

4.1 SAMPLE LOCATION RATIONALE

As explained in the SSR, the entire data set includes three categories of locations to obtain a practicable and sufficient data set from a subset of drainage basins/outfalls within the Site. These locations were sampled by the LWG and Port of Portland (Terminal 4) during two sampling efforts in the spring/summer of 2007 (first round) and the fall/winter of 2007-2008 (second round). As previously mentioned, one additional site (GE Decommissioning) was sampled by GE, and these results will also be used in the overall LWG stormwater data set. This site is located within the City of Portland OF-17 stormwater basin, and data collected from this site only represent a small portion of the stormwater runoff associated with OF-17. In additional, in early 2008, the City of Portland collected three additional samples to supplement the residential data set; these samples are included as well. The three categories of locations are:

- **Representative Land Use Locations.** Fifteen locations were selected as representative of five of land use (based on zoning) within the overall drainage area. These land use types are as follows:

  - Residential (two locations) representing less than 8 percent of the overall drainage to the Site
  - Major transportation corridors (two locations, plus one additional location as discussed in Section 4.3.3) representing approximately 2 percent of the overall drainage to the Site.
  - Heavy industrial land use (five locations) representing approximately 25 percent of the overall drainage to the Site.
  - Light industrial land use (four locations) representing approximately 8 percent of the overall drainage to the Site.
  - Parks/open space land use (one location) representing approximately 57 percent of the overall drainage to the Site.
- **Specific (Non-representative) Industrial Locations.** Fifteen industrial locations were selected for sampling based on potentially unique or unusual chemical sources that cannot be easily extrapolated from generalized land use measurements.
- **Multiple Land Use Locations.** Two locations were selected to directly measure stormwater discharge from relatively large basins that have a mixture of land use zones to provide a cross-check with land use loading estimates. Additionally, as discussed in the FSR, during the first round of sampling, the Highway 30 location was inadvertently sampled in a location that included runoff from both highway and industrial areas. The samples from this location will be referred to as Yeon Mixed Use and will also be used as a cross-check for land use loading estimates. (The Highway 30 location was sampled at the correct location during the second round of sampling and is called Highway 30 "A.")

The specific locations sampled within each of these categories are shown in Table 4-1 and Figure 4-2. As discussed in the SSR, the overall sampling approach for the Terminal 4 sampling locations is very similar to that described in the FSP, and the data generated are expected to be consistent with those generated at other locations. Data collected by the GE Decommissioning Facility and the City of Portland were also generally consistent with FSP requirements.

4.2 DATA USE

Stormwater composite water and sediment trap data was used in different ways depending on which category of location they represent.

4.2.1 Representative Land Use Locations

Chemical concentration data from the first category of locations (representative land use locations) was pooled by land use type to develop chemical concentrations that are representative of each land use category. These values were used to estimate loading for other basins with the same land use where site-specific data are not available.[3] For example, stormwater chemical concentrations measured from residential land use basins were applied to other residential land use basins that were not sampled and converted to extrapolated loads based on the estimated volumes of stormwater discharged from each residential basin within the Site. As discussed in Appendix B, less dense rural residential land uses were included in the open space land use category since it was measured as part of the open space location during the RI/FS stormwater sampling. Note another kind of land use commonly evaluated in stormwater investigations is the "commercial" category, but this is a very minor use (less than 1 percent) within the overall drainage and was judged not to warrant a specific sampling location. Data from the residential land use type was used for commercial land use areas. The resulting series of extrapolations will provide total stormwater loads for these land uses across the entire Site drainage for input into the fate and transport model and other estimation tools. An important step in this evaluation (as detailed later) is to examine the results for representative land use heavy industrial locations for potential outliers that indicate the location is indeed non-representative for one or more chemicals. In this case, the site data was converted to the non-representative industrial location category for the chemicals in question.

4.2.2 Non-representative Industrial Sites

Chemical concentration data from the second category of locations (non-representative industrial sites) was used in two ways. First, the data was used to develop loading rates for the specific basin associated with that sampling location or associated site. Appendix B includes a discussion of extrapolating loading rates from individual basins to industrial sites. Second, for locations where the non-representative chemical character of stormwater only applies to a specific chemical or chemical group, the other chemical concentrations measured at this location were pooled with the heavy industrial representative land use category data as described above. For example, a metals handling facility may have a non-representative chemical character for one chemical or chemical group (e.g., arsenic or metals), but the other chemicals (e.g., polychlorinated biphenyls [PCBs], semivolatile organic compounds [SVOCs], etc.) may be used in the heavy industrial representative land use data set. A specific example is OF-22B, which is a representative heavy industrial land use location for most analytes, but is a non-representative site for pesticides because of historical industrial activities in the area.

The data reduction approach for sampling locations at non-representative industrial sites is described in Section 4.3.3.

4.2.3 Basins with Multiple Land Uses

The third category of locations (basins with multiple land uses) was not used for extrapolated loading estimates because these locations measure a variety of land uses in one sample. These results were used as an independent verification of extrapolated loads

[3] Because industrial sites are expected to demonstrate a higher degree of variability in contaminant concentrations than other land uses, the list of sampling sites includes a higher proportion of heavy industrial land use sites in an attempt to better capture this variability

to check against the extrapolated load methods and determine uncertainties in the overall approach. Multiple land use basins are further discussed in the uncertainty Section 7.2.

4.3 DATABASE DEVELOPMENT AND RULES

Integral's LWG project database contains all of the data reported by the analytical laboratories. This includes field and laboratory replicates, laboratory dilutions, results for the same analyte from multiple analytical methods (e.g., SW8270 and SW8270-SIM), and laboratory quality assurance (QA) samples such as matrix spikes, surrogates, and method blanks. The data-handling rules described in Guidelines for Data Averaging and Treatment of Non-detected Values for the Round 1 Database (Kennedy/Jenks et al. 2004) were typically used to create a simpler data set for the Site Characterization and Risk Assessment (SCRA) database users; the data set contains only one result per analyte per sample, excludes all of the laboratory QA results, contains only the most appropriate dilution result and analytical method for each analyte, and contains the average of the replicates.

For the stormwater loading data set, several deviations from the SCRA database rules were made based on the Stormwater Technical Team's decision. Specifically, the SCRA reduction step of reporting only one result for a sample was not employed for the stormwater loading database because the Stormwater Technical Team requested inclusion of all laboratory replicate and field duplicate results for evaluation. Treatment of replicates and duplicates is discussed below in Section 4.3.2.

The RI data summation methods were used in the stormwater loading calculations for the RI report. Summation rules for stormwater loads for the QEAFate model (PCB homologs) were consistent with the risk assessment summing rules. Section 2 of the RI report summarizes these methods.

Once the LWG database was prepared, it was queried to reduce it to a "working database" to include just those chemicals on the subject stormwater loading IC list per Table 3-1.

4.3.1 Records Peremptorily Excluded

Particular records from one location were peremptorily excluded from the working database as discussed by the Stormwater Technical Team. This location, WR-3, was inadvertently sampled during Round 3A sampling. That is, the outfall sampled was thought to drain the primary area of interest on the Sulzer site, but further analysis of updated drainage plans for the Sulzer site indicated it drains another area entirely. Because the area draining to WR-3 could not be confirmed, and the actual basin of interest (WR-4) was sampled during Round 3B, the sediment and composite water samples from WR-3 were excluded from the loading analysis

4.3.2 Duplicate Analysis

The objective of this step of the data reduction process was to compare paired field duplicate/lab replicate and normal results for the subset of samples for which these data are available. (Field duplicates were generated in the field lab based on composite water samples from the same container of mixed composite water. Laboratory replicates were generated in the lab by splitting sample water in the same submitted sample container into two aliquots for separate laboratory analysis.) For simplicity in this document, field duplicates and lab replicates are collectively referred to as "duplicates" and these two types of paired samples were handled in the same way for the purpose of generating loading estimates.

For individual chemicals and sums, the process explained in the attached flow chart, Figure 4-3, which is consistent with EPA general comments and method agreements, was used to further evaluate duplicate outliers in stormwater. Detailed evaluation regarding how to handle replicate/duplicates required is presented in Table 4-2. Table 4-2 also presents the rationale for the recommended duplicate handling following the decision process shown in Figure 4-3. Additionally, Table 4-2 lists all duplicates with relative percent difference (RPD) values exceeding the levels presented in Table 4.2 of the Portland Harbor RI/FS Round 2 QAPP Round 3A Stormwater Sampling (Integral 2007). Since no RPD limit was specified for PCBs, the screening level RPD for phthalates, pesticides, and polycyclic aromatic hydrocarbons (PAHs) was used, which is plus or minus 30 percent for stormwater.

For this preliminary screening process, all non-detect results were included at one half the detection limit. Given that this is a preliminary step in the process the assumption of half the detection limit is appropriate as discussed, for example, in ProUCL guidance. Also, for this particular analysis, divergence of duplicate samples that is a result of non-detects is specifically evaluated in one step, where the effect, if any, of the detection limit assumptions can be specifically addressed.

The screening resulted in 89 parent and replicate/duplicate pairings out of approximately 500 total pairings having an RPD greater than the screening factor and therefore retained for further evaluation as presented in Figure 4-3. Through the additional analysis, 27 parent and duplicate pairings were subjected to some kind of "segregation" evaluation, which is approximately 5 percent of the pairings. In other words, in 95 percent of the cases, duplicates were averaged per standard RI database rules.

Additionally, out of the 27 pairs subjected to segregation and summarized in the attached Table 4-2, eight of these pairs are from OF-18, which is a multiple land use location. Data from multiple land use sites were collected with the intent to perform an uncertainty analysis and are not used directly in any loading calculations. Therefore, these samples are not further discussed here, but are included in Table 4-2 for reference and are discussed further in Section 7.2.1.

Out of the remaining 19 cases, only one pair was completely segregated (removed) from the stormwater loading working database. In the other 18 cases, either the parent or the duplicate was segregated and the other half of the pair was retained in the working database.

Due to the limited data set for sediment traps, all sediment trap duplicates were averaged with parent samples. There are two exceptions to this rule: sediment samples collected from the catch basins holding the sediment trap samples at WR-107 and WR-14. These duplicate samples were used for laboratory QC analyses only and were not included in loading calculations.

4.3.3 Categorization of Sites within Land Uses

The SSR segregated stormwater sample locations into one of several land use categories as discussed in Section 4.1. These included heavy industrial, light industrial, open space, residential, and major transportation land use categories. In addition, some heavy industrial and light industrial sites were categorized as *a priori* non-representative, anticipating that these would not be used in the calculation of representative heavy and light industrial stormwater loads. It should be noted that since the development of the SSR, the *a priori* assumptions were refined by the Stormwater Technical Team, together with EPA, in order to identify specific chemical groups at specific locations for further analysis. The chemicals and locations chosen for further analysis as non-representative locations are listed in Table 4-3.

The primary purpose of this step in the stormwater loading analysis is to use both quantitative and qualitative (i.e., graphical) methods to evaluate whether the assignments of land use categories and non-representative heavy and light industrial sites in the FSP contain outliers that could be reassigned to some other land use category. In essence, this step of the evaluation is testing whether the *a priori* assignments made in the SSR (and refined by the Stormwater Technical Team) are supported by the data obtained, or alternatively, whether these actual data indicate that a different categorization is more appropriate.

For individual chemicals and sums, the process explained in the attached flow chart, Figure 4-4, was used to evaluate the classification of data. Figure 4-4 is consistent with general EPA comments and method agreements for this evaluation. Locations with both heavy industrial and light industrial land use types were evaluated. There were no sites in the residential and open space land uses identified for further analysis; therefore, the reclassification analysis does not address these land uses.

Additionally, as agreed by the Stormwater Technical Team and EPA, St. Johns Bridge data were examined as part of a separate process and are discussed separately in Section 4.3.4.

Per Figure 4-4, the evaluation process generally followed two broad steps. The first step assessed whether representative locations should remain representative or become non-representative, and the second step assessed whether non-representative sites were better categorized as representative. The results are summarized in Table 4-4a-f, which provides the decisions made for Step 1 and Step 2 and the resulting recommended final categorization. Appendix C includes more detailed background information for Step 1 and Step 2.

Note that each chemical within each chemical group was evaluated separately to determine final categorizations, with the exception of PCBs. For PCBs, locations were classified as representative or non-representative on the basis of the entire set of congeners and Total PCBs, and therefore, a site could not be non-representative for one congener and representative for another congener.

Overall, the reclassification analysis resulted in many locations being reclassified from non-representative to representative and a smaller number of locations being reclassified from representative to non-representative. Summary statistics on the stormwater data were compiled after this reclassification analysis was completed. A summary of the non-representative locations for each IC is included in Table 4-5.

Several locations were reclassified from representative to non-representative solely on the basis of outlier non-detect values. These locations are listed in Table 4-5 and are included in the working database for reference, but the non-representative loading rates from these sites were not included in the calculation of total loads; instead the "representative" land use loading rate was applied. These locations and corresponding chemicals include:

- Schnitzer WR-384: PCB 169
- GE Decommissioning Facility: arsenic
- Arkema WR-96: dieldrin and total chlordanes
- OF-22B: 4,4' DDT and gamma-hexachlorocyclohexane

4.3.4 Evaluation of St. Johns Bridge (WR-510) Data

The purpose of this analysis is to compare sediment trap and stormwater composite water data collected at the St. Johns Bridge with data collected at 1) representative major transportation sites within the study area (i.e. Hwy 30A and Hwy 30B); and 2) regional and national literature values for stormwater runoff from transportation land uses. Due to concerns regarding initial data results for this location, it was segregated from the initial data set for further evaluation, and another major transportation land use location was sampled to replace it. The objective of the St. Johns Bridge analysis is to evaluate the St. Johns Bridge data to determine if they are similar to data from other major transportation land use locations.

The St. Johns Bridge data were originally segregated from the data set based on concerns regarding data collection at this location. Based on comparison to the representative land use data and available literature values, stormwater sediment trap and composite water data from St. Johns Bridge demonstrates reasonable concordance with other transportation land use locations. No clear or consistent differences or patterns between the St. Johns Bridge and other transportation sites or land uses were observed. Thus, inclusion of the St. Johns Bridge in the representative transportation land use would not be expected to significantly influence loading estimates for this land use with respect to PCBs, metals, and organic chemical concentrations in sediment trap and stormwater runoff. Additionally, the major transportation land use represents approximately 2-3 percent of the land use in the study area, and thus, even a large change in the loading rates from the major transportation land use would not greatly impact the overall river loading estimates. Given that St. Johns Bridge data were initially segregated and additional sampling was conducted to replace them, there were logistical considerations in including these data late in the analysis process after the above evaluation was conducted. Therefore, although this analysis indicates that St. Johns Bridge could have logically been included in the major transportation data set, it is clear that the decision to not include the St. Johns Bridge data would not have any measurable impact on the study results.

4.3.4.1 Methods

Summary statistics on pooled, raw data from the St. Johns Bridge were compared to the representative data for the major transportation land use. Figures 4-5 through 4-9 compare average values for metals, organics, and PCBs in both sediment trap and composite stormwater matrices. Note that metals were not analyzed in sediment trap samples at St. Johns Bridge due to limited sample mass as shown in Table 3-3. Tables 4-6 and 4-7 include side-by-side comparisons of summary statistics.

Representative literature values were compiled from two sources: *Control of Toxic Chemicals in Puget Sound Phase 2: Improved Estimates of Loadings from Surface Runoff and Roadways* (EnviroVision et al. 2008) and *Portland Harbor RI/FS Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report Appendix D: Loading, Fate, and Transport* (Integral et al. 2007). Each literature source compiled transportation land use stormwater runoff data from both regional and national sources and calculated summary statistics (to the extent possible) for numerous metals and organic chemicals. Unfortunately, sufficient data were not available in the literature to estimate stormwater runoff within this land use for several chemicals, including PCBs, chromium, and nickel.

EnviroVision et al. (2008) compiled measured runoff concentrations primarily from regional studies where available, supplemented by national data when regional data was not available. Sources compiled included the Thomas Scientific Web, open literature, and the International Stormwater Best Management practices database. Data were restricted primarily to edge-of-pavement studies and did not include studies where results represented transportation land use co-mingled with other types of land use.

Integral et al. (2007) compiled literature values primarily from the National Stormwater Quality (SWQA) database and a data compilation report of a National Pollutant

Discharge Elimination System (NPDES) stormwater monitoring program in Portland, Oregon (Woodward-Clyde 1997). A search of the open literature did not identify any studies that would provide a meaningful range of stormwater values for analytes not addressed by the above sources (i.e., PCBs). In fact, several of the studies in the open literature acknowledged a data gap in the understanding of PCB loading from transportation land uses. Table 4-7 compares values from these sources to the St. Johns Bridge stormwater composite water data, as well as LWG-collected representative major transportation land use data.

4.3.4.2 Results

Differences in sediment trap PCB and other organic chemical concentrations between St. Johns Bridge and LWG collected representative major transportation land use were minimal. Due to the small number of samples (one to two), these comparisons have a high degree of uncertainty. Nevertheless, St. Johns Bridge and representative transportation land use demonstrated differences less than an order of magnitude and frequently less than a factor of three (i.e., RPD less than 100%) in sediment trap samples. The exception is Total PCB Congener toxic equivalent quotients (TEQ). In this case, the St. Johns Bridge data were approximately two orders of magnitude lower than the representative major transportation land use data.

Similarly, differences in composite water PCB, other organics, and metal concentrations between St. Johns Bridge and LWG-collected representative transportation land use data were small. Generally, St. Johns Bridge concentrations of PCBs, organics, and metals were higher but only slightly; differences did not exceed a factor of three (RPD less than 100%).

Comparison of St. Johns Bridge data to literature values tended to show higher divergence. Figure 4-10 shows the range of St. Johns Bridge values compared to reported literature values. In most cases, literature central tendency estimates (e.g. mean, median, geomean, or midpoint) fall within the range of St. Johns Bridge values and/or are within one order of magnitude of the St. Johns Bridge mean value.

4.3.4.3 Conclusions

The St. Johns Bridge data were originally segregated from the data set based on concerns regarding data collection at this location. Based on comparison to the representative land use data and available literature values, stormwater sediment trap and composite water data from St. Johns Bridge demonstrates reasonable concordance with other transportation land use locations. No clear or consistent differences or patterns between the St. Johns Bridge and other transportation sites or land uses were observed. Thus, inclusion of the St. Johns Bridge data in the representative transportation land use would not be expected to significantly influence loading estimates for this land use with respect to PCBs, metals, and organic chemical concentrations in sediment trap and stormwater runoff. Additionally, the major transportation land use represents approximately 2-3percent of the land use in the study area, and thus, even a large change in the loading rates from the major transportation land use would not greatly impact the overall river loading estimates. Given that St. Johns Bridge data were initially segregated and additional sampling was conducted to replace them, there were logistical considerations in including these data late in the analysis process after the above evaluation was conducted. Therefore, although this analysis indicates that St. Johns Bridge could have logically been included in the major transportation data set, it is clear that the decision to not include the St. Johns Bridge data would not have any measurable impact on the study results.

4.3.5 Special Processing of Sediment Trap Data

Sediment trap data were collected during both Rounds 3A and 3B stormwater sampling. As previously mentioned, the purpose of Round 3B sampling was to fill data gaps where data were not collected in the first round. However, there are a few instances where the same analyte was measured at the same location during both Rounds 3A and 3B. This occurred if a limited sample mass collected during Round 3A led to elevated detection limits. Thus, it could be expected that some non-detect values occurred in Round 3A due to limited sample mass. In this case, the analytes were measured again during Round 3B if sufficient sediment was available.

There were sixteen instances where there was a non-detect sample collected for a particular analyte during both Round 3A and Round 3B. In most cases, the non-detect values in Rounds 3A and 3B were similar. However, in the case of three pesticide samples collected at OF-49, the non-detect values from Round 3A were ten times greater than the non-detect samples collected during Round 3B. In the case of these three samples, the high non-detect samples collected during Round 3A were segregated (LW3-STW-S10-OF49 for 4,4'-DDD, aldrin, and gamma-hexachlorocyclohexane). In all other cases with non-detect values for Rounds 3A and 3B, samples for sediment traps were averaged prior to calculation of any statistics.

In general, for sediment traps, if two detected samples existed for a particular sampling location, then the samples were averaged so there is only one result per analyte and sampling location. If there was one non-detect and one detect sample, then the detect sample was retained, and the non-detect sample was segregated. If both samples are non-detect, then the samples were averaged and the non-detect qualifier remained except in the three cases discussed above. This procedure differs from the treatment of the composite water samples, where there are generally at least three samples for each analyte and sampling location.

Additionally, it should also be noted that the sediment trap samples from WR-96 included in the working database were excluded from analysis because the sample was from catch basin solids as opposed to in-line sediment trap samples. These exclusions are discussed further in the uncertainty analysis section.

4.4 STORMWATER LOADING WORKING DATA SET

Once the steps outlined above in Section 4.3 were completed, the stormwater working database was finalized. This database is included in Appendix D, Table D-1 and includes the land use classification for each sample and whether the location and chemical is representative or non-representative for a particular land use. For sediment trap data, organic compounds are presented as both organic carbon (OC)-normalized and raw (non-normalized) to allow for two ways of calculating the sediment trap loading rate as further explained in Section 4.5.2 and Section 6.

The method for generating summary statistics, and corresponding stormwater loads using this data set is explained below in Sections 5 and 6 for stormwater composite water and sediment trap data respectively.

4.5 ESTIMATION OF LONG-TERM LOADS

Ideally, estimation of long-term loads would involve a large number of composite water and sediment trap samples taken over the course of many years and many types of storms, pollutant sources, and runoff conditions. However, such an approach is not necessary to meet the objectives for the FSP and would have caused unacceptable schedule delays for the RI/FS. Therefore, both stormwater composite water chemistry samples and sediment trap chemistry samples were collected at the locations listed in Table 4-1 and shown in Figure 4-2. These two measurements provide data to support two independent means of estimating stormwater chemical loads as explained in Sections 4.5.1 and 4.5.2.

It is anticipated that these two methods (composite water and sediment traps) will result in different predictions of mass loading at most locations. The reason for having two independent methods to estimate loads is that each method has intrinsic measurement artifacts that will lead to varying load estimates. The advantages and disadvantages of each method are to some extent complementary. By using two approaches, the disadvantages of each method can be better understood and the two loading estimates provide a better overall sense of the potential range of chemical loads. The advantages and disadvantages of both methods are discussed in the SSR.

It should be noted that loads estimated from the snapshot of stormwater composite water and sediment trap data in this study by definition cannot include any future changes that may occur in the watersheds such as source controls and/or changing land uses over time. Additionally, the estimated loads do not account for changes that have occurred since the subject sampling occurred in 2006 to 2008. Consequently, these future changes must be evaluated on a more general basis using tools that are commonly applied to watersheds in the absence of detailed stormwater chemical data. This will be one subject that will be discussed in more detail in the recontamination analysis that will be undertaken for the FS.

4.5.1 Composite Water Based Method

For composite water, chemical concentrations (mass chemical/volume water) are multiplied by the volume of water discharging at the location over a set time to yield a chemical load in mass/time.

4.5.1.1 Runoff Volumes

Runoff volumes were calculated for each river model cell (Figure 4-11) adjacent to the uplands using the City of Portland Bureau of Environmental Service's GRID model. The sections of the river line up with the AFT model segments. As discussed above, EPA and LWG have agreed to use QEA Fate instead of the AFT model. However, it is expected that stormwater loads would be input to that model at the same resolution of shoreline segments as currently planned. The GRID model is explained further in Section 5.2.1 and Appendix B.

Additionally, runoff volumes were calculated for each upland property listed in Table 4-5; loads to the Site from these locations will be input into the model separately for certain chemicals because they were deemed to be non-representative through the data analysis explained in Section 4.3.3. Additional discussion on calculating volumes from non-representative locations is included in Appendix B.

4.5.1.2 Chemical Water Loads

Chemical water loads were calculated by multiplying the measured chemical concentrations in composite water samples (mass of chemical per volume of water sample) by the volume of water discharging at the location over a set time to yield a load in mass/time.

$$L = C_w \times V_{month}$$

Where:

L = Load (microgram [µg]/month)

C_w = Measured concentration (µg/L) for land use or site

V_{month} = Volume of discharge from land use or site over a month (L/month)

The monthly stormwater chemical load for a given drainage area, in units of kg/month, is mathematically equivalent to the following calculation:

Monthly stormwater water chemical load (kg/month) = heavy industrial stormwater chemical load (kg/month) + light industrial stormwater chemical load (kg/month) + residential stormwater chemical load (kg/month) + parks/open space stormwater chemical load (kg/month) + major transportation stormwater chemical load (kg/month) + "non-representative" location stormwater chemical load (kg/month).

4.5.2 Sediment Trap Based Method

4.5.2.1 Runoff Volumes

As with the stormwater composite water method, runoff volumes were calculated for each river model cell (Figure 4-11) adjacent to the uplands using the City of Portland Bureau of Environmental Service's GRID model. The GRID model is explained further in Section 5.2.1 and Appendix B. Additionally, runoff volumes were calculated for each non-representative industrial location as loads to the Site from these locations will be input into the model separately. Additional discussion on calculating volumes from non-representative locations is included in Appendix B.

4.5.2.2 Chemical Solids Loading

Chemical solids loads for non-OC-normalized data were calculated by multiplying the measured trap solids chemical concentrations (mass of chemical/mass trap solids) by the TSS (mass of suspended solids per volume water sample) by the volume of water discharging at the location over a consistent time frame to yield a load in mass/time. For example, using a per month basis:

$$L = C_s \text{ x } TSS \text{ x } V_{month}$$

Where:

L = Load (µg/month)

C_s= Measured concentration (µg/kg) in trap solids for land use or non-representative site

TSS = Total suspended solids (kg/L) in stormwater measured for land use or non-representative location

V_{month} = Volume of discharge (L/month) from land use or non-representative location over a month

Analogously, TSS was replaced with TOC (kg/L) in the above equation and C_s was converted to TOC-normalized value in µg/kg of OC to yield the load in kg/month on an OC-basis. TSS and TOC concentrations are included in the stormwater working database in Appendix D, Table D-1. The geomean concentrations by land use and non-representative location of TSS and TOC are included in Appendix D, Table D-2.

The monthly chemical solids load for a given drainage area, in units of kg/month, is mathematically equivalent to the following calculation:

Monthly chemical solids load (kg/month) = heavy industrial chemical solids load (kg/month) + light industrial chemical solids load (kg/month) + residential chemical solids load (kg/month) + parks/open space chemical solids load (kg/month) + major transportation chemical solids load (kg/month) + "non-representative" location chemical solids load (kg/month).

5.0 STORMWATER-BASED LOADS

This section details the method for evaluating stormwater data and using the data to estimate stormwater loads to the Site.

For purposes of fate and transport modeling, a full range of potentially useful summary statistics including central tendencies and confidence limits were generated such that evaluations of various types of loading estimate scenarios and modeling sensitivity analyses can be supported. The intent is to use various estimates of stormwater loads to assess the river modeling calibration and determine those chemicals for which large changes in assumed stormwater loads are relatively minor as compared to overall loads to the river. ProUCL, statistical analysis software developed by the EPA, was used to calculate advanced statistics for these analyses.

Careful evaluation of each particular data set and land use was important to evaluate statistics that may be more or less applicable in a given situation. For data sets with smaller sample size (n), some types of statistics are of questionable value as noted in detail below, and in these cases, simpler estimates may be preferred.

5.1 SUMMARY STATISTICS

As noted above, summary statistics generated were often based on data sets with few observations and/or detected values. Hypothesis testing (i.e., goodness-of-fit [GOF]), interpolation (i.e., Regression on Order Statistics [ROS]), and estimation (i.e., UCL) methods used to generate summary statistics may not be appropriate or reliable due to the uncertainty in the representativeness of the data set for the population of interest. In addition, ProUCL has incorporated minimum sample size requirements into the statistical routines and may not provide such statistics or test results for small data sets. As such, the following decision rules, based on both statistical principles and recommendations provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007) and practical limits of the ProUCL software, were used to determine whether specific test results or statistics would be calculated and presented in summary statistics. The decision rules are as follows:

- For analyte/matrix/land use combinations with $5 <= N < 8$, advanced summary statistics were generated and presented but should be interpreted with caution due to the limited number of samples
- For analyte/matrix/land use combinations with $5 <= N < 10$, bootstrap methods for estimating UCL were avoided due to uncertainties in the bootstrapping operation with low sample numbers; ProUCL recommends a minimum of 10 to 15 samples for bootstrapping operations.
- For analyte/matrix/land use combinations with less than four detected observations, GOF, ROS, and bootstrap operations are unreliable and were not used. ProUCL will not generate GOF, ROS-based summary statistics, and bootstrap estimates for this scenario.

As discussed with the stormwater technical team and EPA, there are several different ways of looking at the data, and grouping data within different land uses before generating summary statistics. In general, it was agreed that the data would be grouped in three different ways, and the methods for each of these three different ways are discussed below:

- Unweighted Composite Water Data
  - With data pooled by chemical and land use, indicated as "pooled data" as discussed in Section 5.1.1.1
  - With data averaged by site, and then pooled by chemical and land use, indicated as "Averaged by Site data" statistics as discussed in 5.1.1.2
- Weighted Composite Water Data - Summary statistics on data averaged by site and weighted using a unit flow factor indicated by "Averaged by site and Weighted Data " as discussed in 5.1.2

Additionally, the method for generating summary statistics for non-representative locations varies due to the small dataset available for each location and is discussed in Section 5.1.3.

5.1.1 Summarize Unweighted Composite Water Data

Summary statistics on unweighted data were calculated by land use and presented in two ways in flat file form in Appendix D, Table D-2:

1. Pooled Data
2. Averaged by Site Data

Note that blanks shown in Table D-2 indicate that the statistic in question was not calculable for the various reasons stated throughout this section. Methods for generation of summary statistics for each of these two types of data aggregation are described in the next two subsections.

5.1.1.1 Summary Statistics for Pooled Data

The following procedure was used to calculate summary statistics for the pooled data:

1. Data for each land use was reformatted to meet ProUCL requirements. Records identified as non-representative were treated as independent data sets on a chemical- and location-specific basis. Statistics were only calculated to the extent practical in accordance with Section 5.1.
2. ProUCL was used to conduct graphical and statistical (i.e., GOF) tests to determine the underlying data distribution (or lack thereof) for each chemical and land use. ProUCL was not used for the non-representative site data due to the limited number of samples and detects.

3. ProUCL and Microsoft Access were used to generate summary statistics consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007). Statistics of interest are shown in Table D-2.

5.1.1.2 Summary Statistics for Averaged by Site Data

The following procedure was used to calculate summary statistics for the averaged by site data:

1. Using the same data as in Step 1, the lognormal ROS method was used to impute non-detect values using the pooled data set. Estimation of values for non-detects was necessary in this step in order to estimate the averages by site, because sample numbers or detected sample numbers were too small on a per-site basis to use other techniques (i.e., Kaplan-Meier) to estimate averages for each basin. A lognormal distribution was used in the ROS estimates for the following reasons: 1) the normal ROS estimation method frequently imputes negative values for non-detects, which is not possible; and 2) environmental data frequently assumes a lognormal distribution; hence, there is an underlying assumption of lognormality for these stormwater data. In cases where there ROS method was unreliable due to limited samples or limited detected samples as described in Section 4.1, half the detection limit was substituted for each non-detect value.
2. The data were averaged by site, in order to come up with one value for each sample location. ProUCL was used to generate summary statistics on the averaged data consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007). Statistics of interest are shown in TableD-2.

5.1.2 Summary Statistics for Averaged By Site and Weighted Data

Summary statistics on data averaged by site and weighted using a unit flow factor are presented Table D-2 and indicated by "Averaged by site and Weighted Statistics." The steps for this calculation were:

1. Using the same data set created above in Step 2 with substituted values for non-detects and data averaged by site, the data were weighted using the following method:

   $$C_{weighted} = C \times W \times N, \text{ where}$$

   Where:

   $C_{weighted}$ = the average weighted concentration from each sample location

   W = weighting factor; a unitless factor for each sample location based on its unit runoff volume divided by the sum of all unit volumes for all locations, as further discussed in Appendix B

N = the number of sample locations in a land use category

2. ProUCL and Microsoft Access were used to generate summary statistics on the averaged data consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007). Statistics of interest are shown in Table D-2.

5.1.3 Summary Statistics for Non-Representative Locations

The method for generating summary statistics for non-representative locations varies due to the small dataset available for each location.

Because it was not possible to use ROS or Kaplan-Meier to calculate means for each individual sample location due to the limited number of samples and non-detects, half the detection limit was substituted for non-detects.

Statistics were only calculated to the extent practical in accordance with ProUCL guidance due to the small data set associated with each. Statistics of interest are shown in Table D-2. Note that there is only one statistic (mean) presented for unique sites in the "averaged by site data" and the "weighted data." This is because once a non-representative site is averaged by location, only one data point exists.

5.2 FLOW VOLUME METHOD

Flow volumes were calculated by the City of Portland Bureau of Environmental Services (BES) using the GRID model.

5.2.1 Description of GRID Model

The GRID model (City of Portland 2006) is a GIS-based reconnaissance-level pollutant model developed by the BES. The GRID model is used as a part of this stormwater loading calculations effort to provide flow volumes only.

Data that were compiled for each 100-foot by 100-foot grid include precipitation, pervious/impervious area, and zoning area (or land use). A map showing pervious/impervious area and land use is included in Appendix B. Using these data, runoff volumes for various land use types were calculated using a series of equations known as the "Simple Method" developed by Schueler (1987).

The runoff volume calculation within the Simple Method is determined from:

$$R = P * Pj * Rv$$

Where:

R = Annual runoff per unit area (cm/month)

P = Annual rainfall (cm)

Pj = Fraction of monthly rainfall events that produce runoff (usually 0.9)

Rv = Runoff coefficient (unitless).

Annual runoff per area (R) is then converted to units of volume/month (e.g., L/month) based on the depth (cm) of runoff times the area in (e.g., cm^2) in question.

5.2.2 Period for Analysis and Calibration/Validation Period for Hybrid Model

Five "typical" flow years (all starting September 1 of the year noted and ending August 31 of the following year) were calculated using the GRID model. These years were selected to match the years planned to be run using the Hybrid Model during the RI/FS process (Anchor et al. 2007):

- 5th Percentile Flow Year 2000 – mean flow 454 cubic meters per second (m^3/sec)
- 25th Percentile Flow Year 1990 – mean flow 801 m^3/sec
- 50th Percentile Flow Year 2002 – mean flow 863 m^3/sec
- 75th Percentile Flow Year 2005 - mean flow 1,099 m^3/sec
- 95th Percentile Flow Year 1996 – mean flow 1,522 m^3/sec

Additionally, two flow periods were to be used for calibration and validation:

- September 1, 2004 through January 31, 2006 (17 months)
- September 1, 2006 through January 31, 2008 (17 months)

However, with further development of the QEAFate model, the calibration and validation periods were expanded to encompass the entire period of January 2002 through December 2008.

5.2.3 Monthly Flow Volumes

Volumes were calculated on a monthly basis, because this was the smallest unit of time expected to require differentiation of loads for input to the Hybrid Model. It was chosen so that seasonal variations in stormwater loads can be accounted for in the model; for example, little if any stormwater loading would be expected in the summer months.

Monthly flow volumes were calculated for each of the months from January 2002 through December 2008 in order to account for seasonal variations in stormwater flow.

Monthly flow volumes were calculated by the City of Portland BES using the GRID model and provided by land use type and non-representative industrial location for each cell of the Hybrid Model as shown in Figure 4-11. Note that while a volume is provided for every site that is non-representative for at least one chemical, the non-representative loading rate is applied on a chemical by chemical basis. Thus, for a particular chemical, if a site is non-representative then the volume of runoff from that site will be subtracted from the general land use volume, and a non-representative load will be calculated. Further discussion of calculations of flows is included in Appendix B.

5.3 LOAD CALCULATION

As discussed above, the monthly chemical solids load for a given drainage area, in units of kg/month, is mathematically equivalent to the following calculation:

Monthly chemical solids load (kg/month) = heavy industrial chemical solids load (kg/month) + light industrial chemical solids load (kg/month) + residential chemical solids load (kg/month) + parks/open space chemical solids load (kg/month) + major transportation chemical solids load (kg/month) + "non-representative" location chemical solids load (kg/month).

The sections below detail some of the specific data and assumptions for generating chemical solids loads.

5.3.1 Use of Sediment Trap Data in the Absence of Composite Water Data for Estimating Loads

Stormwater loads for pesticides were approached in a slightly different manner than loads for metals, PAHs, or PCBs due to a lack of representative composite water samples. Pesticides were only analyzed at a small subset of locations in composite water samples, but were analyzed at nearly all locations in sediment trap samples.

Composite water samples collected from parks/open space or transportation land uses were not analyzed for pesticides; additionally, limited composite water samples (i.e. one or two) from light industrial and residential land uses were analyzed for pesticides. However, a larger number of sediment trap samples from each of the aforementioned land uses was collected and analyzed for pesticides. In order to more accurately approximate the pesticide loading rates to the Site, sediment trap data and statistics were substituted for composite water statistics for light industrial, parks/open space, residential, and transportation land uses. This method was also used for non-representative locations that did not have composite water data (i.e. WR-147). The appropriate sediment trap data for a specific land use or non-representative location was multiplied by the geomean TSS value for the land use or location to obtain a "surrogate" composite water value. These surrogate composite water values were then used to calculate stormwater composite water loads to the Site.

5.3.2 Load Scenarios

A range of summary statistics were generated for each land use (or non-representative location) and each chemical for those chemicals to be modeled in the Hybrid Model, and is included as a flat file in Appendix D, Table D-2. These values were used to calculate separate loading "scenarios" for each chemical. The exact application of the loading scenarios has not been determined and will be part of the Hybrid Modeling exercises to support the various purposes described in Section 2.2. Examples might include assessing recontamination assuming no new upland source controls are implemented. In this case, loading estimates based on the 95th UCL concentrations might be appropriate. Similarly, a recontamination scenario might evaluate a 50 percent reduction in source loads due to various DEQ and other source control programs. In this case, 50 percent of the 95th UCL concentrations might be used. Because of all of the hypothetical situations that could occur when running the Hybrid Model, it is difficult to list every scenario that may or may not be used as an input using the Hybrid Model. Instead, it is easier to determine different loading scenarios as the results of the model runs progress. Stormwater loading scenarios will be further discussed during the QEAFate Calibration Phase.

For the purposes of calibrating the fate model, seven different statistics were chosen in order to represent a full range of different central tendency estimated stormwater loads to the system, due to various ways of calculating the statistics by pooling all of the data together by land use, averaging the data by site, or averaging the data by site and then weighting the data by the amount of runoff from each site. The loads calculated based on these statistics are shown in Appendix D, Table D-3. (Note that different loading scenarios were chosen for the RI report but are not further discussed in this document.)

For purposes of preliminary calibration runs for the QEAFate model, composite water loads based on statistics averaged by site and then weighted were used, and then these loads were varied in order to determine the sensitivity of the model. This level of variation is generally commensurate with the range of loading estimates obtained by various statistical methods discussed in this report. Composite water and sediment trap based loads are compared in Section 7.4. Further information on loading scenarios will be presented as part of the Hybrid modeling.

6.0 SEDIMENT TRAP-BASED LOADS

This section details the method for evaluating sediment trap data and using the data to estimate stormwater loads to the Site.

As with stormwater based loads, a full range of potentially useful summary statistics including central tendencies and confidence limits were generated such that evaluations of various types of loading estimate scenarios and modeling sensitivity analyses can be supported. The intent is to use various estimates of stormwater loads to assess the river modeling calibration and determine the sensitivity of varied stormwater loads as compared to overall loads to the river. ProUCL, statistical analysis software developed by the EPA, was used to calculate advanced statistics for these analyses.

Careful evaluation of each particular data set and land use was important to evaluate statistics that may be more or less applicable in a given situation. For data sets with smaller sample size (n), some types of statistics are of questionable value as noted in detail below, and in these cases, simpler estimates may be preferred.

Summary statistics for sediment trap data were generated with data grouped in the same way as composite water data. However, since there is only one data point per sediment trap location as discussed in Section 4.3.5, averaging the data by site was not necessary. Therefore, only two types of statistics (unweighted and weighted) were generated.

Unweighted and weighted summary statistics for sediment trap data are presented in Appendix D, Table D-2 in two ways:

1. With raw dry weight sediment trap data
2. With OC normalized sediment trap data for organic chemicals only

The data are shown in two ways because calculation loads on both a dry weight (using TSS in stormwater) and OC (using TOC in stormwater) basis were conducted.

6.1 TSS/TOC DATA

TSS data were used to convert chemical concentrations measured in sediment to chemical loads to the Site as summarized in Section 4.5.2.3. TOC data were used to normalize the sediment chemical concentration data. Loads were calculated using both TOC normalized and non-normalized data. TSS and TOC concentrations are included in the stormwater working database in Appendix C, Table C-1. The geomean concentrations by land use and non-representative location of TSS and TOC are included in Appendix D, Table D-2.

6.1.1 Data Sources

6.1.1.1 Use of TSS Data from Stormwater Composite Samples

TSS measurements from the composite stormwater sampling conducted during Rounds 3A and 3B as part of the FSP and FSP Addendum sampling effort were used. In most cases, sediment traps were installed at the same locations where composite water samples were collected. Two exceptions to this are WR-4 Sulzer and the GE Decommissioning Facility, where there was no feasible location to install sediment traps.

For the most part, sediment traps were installed over the same sampling period as stormwater samples. However, in cases where sufficient composite water samples were collected during the first round of sampling to meet FSP requirements, only sediment traps were installed for the second round of sampling and no composite water samples were collected.

This necessarily means that there are some instances when the collection period for TSS data in stormwater does not completely match the collection period for sediment trap data. However, during conversations with the Stormwater Technical Team, it was decided that in cases where there was no stormwater TSS data collected during the second round of stormwater sampling, data from the first round of stormwater sampling will be used.

6.1.1.2 Use of Composite Water Data in the Absence of Sediment Trap Data for Non-Representative Locations

Stormwater sediment trap loads for pesticides were approached in a slightly different manner than loads for metals, PAHs, or PCBs. For non-representative locations with sediment trap pesticide data that was unavailable due to sampling method inconsistencies (i.e. WR-96), composite water data were substituted in order to calculate a load from that location. In this case, composite water statistics were used as "surrogate" sediment trap statistics. Surrogate sediment trap statistics were then used to calculate the stormwater sediment trap loads to the Site.

6.2 SUMMARY STATISTICS

As noted above, for stormwater data, summary statistics for trap solids were even more often based on data sets with few observations and/or detected values. As such, the following decision rules, based on both statistical principles and recommendations provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007) and practical limits of the ProUCL software, were used to determine whether specific test results or statistics would be calculated and presented in summary statistics. The decision rules are as follows:

- For analyte/matrix/land use combinations with 5<=N<8, advanced summary statistics were generated and presented but should be interpreted with caution due to the limited number of samples
- For analyte/matrix/land use combinations with 5<=N<10, bootstrap methods for estimating UCL were avoided due to uncertainties in the bootstrapping operation with low sample numbers; ProUCL recommends a minimum of 10 to 15 samples for bootstrapping operations.

- For analyte/matrix/land use combinations with less than four detected observations, GOF, ROS, and bootstrap operations are unreliable and were not used. ProUCL will not generate GOF, ROS-based summary statistics, and bootstrap estimates for this scenario.

6.2.1 Summary Statistics for Sediment Trap Data for Representative Land Use Sampling Locations

For both the raw and OC normalized data, the process for calculating unweighted statistics on the data is explained below.

1. After processing sediment trap data as discussed in Section 4.3, data for each land use was reformatted to meet ProUCL requirements. Records identified as non-representative were treated as independent data sets on a chemical- and location-specific basis and are discussed below. Statistics were only calculated to the extent practical in accordance with ProUCL guidance due to the small data set associated with each.
2. ProUCL was used to conduct graphical and statistical (i.e., GOF) tests to determine the underlying data distribution (or lack thereof) for each analyte and land use.
3. ProUCL was used to generate summary statistics for each land use consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007). Statistics of interest are shown in Table D-2.
4. After calculating statistics on both OC-normalized and raw data, the chemical solids loading rate (a concentration in terms of mass/volume water) similar to that obtained via composite water was calculated in two different ways and is presented in Table D-2.
    a. The measured sediment concentration statistics (Csraw in µg/kg) were multiplied by a central tendency (i.e., geometric mean) of the TSS (in kg/L) measured in composite water for a particular land use or non-representative location to get a concentration in terms of (µg/L) as shown in Table D-2.
    b. The measured OC-normalized sediment concentration statistics (Csoc in µg/kg) were multiplied by the central tendency (i.e., geometric mean) of the TOC concentration (in kg/L) measured in composite water for a particular land use or non-representative location to get a concentration in terms of (µg/L) as shown in Table D-2.

6.2.2 Summary Statistics for Weighted Sediment Trap Data for Representative Land Use Sampling Locations

For both the raw and OC-normalized data, the process for calculating weighted statistics on the data is explained below.

1. Using the sediment trap data set with samples averaged by site as discussed above, the lognormal ROS method was used to impute non-detect values. A lognormal distribution was used in the ROS estimates for the following reasons: 1) the normal ROS estimation method frequently imputes negative values for non-detects, which is not physically possible, and 2) environmental data frequently assume a lognormal distribution; there is an underlying assumption of lognormality for these stormwater data. In cases where the ROS method was unreliable due to limited samples or limited detected samples as described in Section 4.1, half the detection limit was substituted for non-detects.

2. The data were weighted using the following method:

   $$C_{weighted} = C \times W \times N$$

   Where:

   $C_{weighted}$ = the average weighted concentration from each sample location

   W = weighting factor, a unitless factor for each sample location based on its unit runoff volume divided by the sum of all unit volumes for all locations, as further discussed in Appendix B

   N = the number of sample locations in a land use category

3. ProUCL was used to generate summary statistics on the weighted data consistent with recommendations for such statistics provided in the ProUCL Version 4.0 Technical Guide and User Guide (EPA 2007). Statistics of interest are shown in Table D-2.

4. After calculating statistics on both OC-normalized and raw weighted data, the chemical solids loading rate was calculated exactly as described above for unweighted data and is presented in Table D-2.

6.2.3 Sediment Trap Data for Non-Representative Land Use Sampling Locations

The following procedure was utilized for sediment trap data from non-representative locations:

1. There is generally only one data point for each non-representative sampling location, so statistical methods cannot be used to calculate substitution values for non-detects. Therefore, half the detection limit was substituted for non-detects.

2. There is generally only one data point for each sampling location and chemical so no data set statistics were calculated, but the single value for each non-representative location is presented in the Table D-2.

3. The chemical solids loading rate (concentration in water terms) was then calculated from the single value available at each site in the same manner as noted for representative data above; these values are presented in Table D-2.

6.3 LOAD CALCULATION

The monthly chemical solids load for a given drainage area, in units of kg/month, is mathematically equivalent to the following calculation:

Monthly chemical solids load (kg/month) = heavy industrial chemical solids load (kg/month) + light industrial chemical solids load (kg/month) + residential chemical solids load (kg/month) + parks/open space chemical solids load (kg/month) + major transportation chemical solids load (kg/month) + "non-representative" location chemical solids load (kg/month).

The sections below detail some of the specific data and assumptions for generating chemical solids loads.

Sediment loading to the Site was calculated using two different methods. The first method used TSS data, while the second method used OC-normalized data. The calculation based on both TSS and TOC approaches is summarized in Section 4.5.2.2. In each case, the chemical concentration in the sediment trap (either bulk sediment or on an OC-basis) is multiplied by either the geomean TSS or geomean TOC concentration in composite water, which is multiplied by the monthly flow volume. In either approach, the loads were calculated based on a sediment trap chemical concentration statistic and TSS/TOC statistic that represents the pooled data sets (both chemical concentrations and TSS/TOC) for that land use. (Or in the case of non-representative sites, the single chemical concentration from that location and the geomean on the relatively small number of TSS/TOC values for that non-representative location.)

6.3.1 Use of Composite Water Data in the Absence of Sediment Trap Data for Estimating Loads

For non-representative locations with sediment trap data that were unavailable due to sampling method inconsistencies (i.e., WR-96), composite water data were substituted in order to calculate a load from that location. In this case, composite water statistics were used as "surrogate" sediment trap statistics. Surrogate sediment trap statistics were then used to calculate the stormwater sediment trap loads to the study area.

6.3.2 Load Scenarios

A range of summary statistics were generated for each land use (or non-representative location) and each chemical for those chemicals to be modeled in the Hybrid Model, and is included as a flat file in Appendix D, Table D-2. These values were used to calculate separate loading "scenarios" for each chemical. The exact application of the loading scenarios has not been determined and will be part of the Hybrid Modeling exercises to support the various purposes described in Section 2.2. Examples might include assessing recontamination assuming no new upland source controls are implemented. In this case, loading estimates based on the 95th UCL concentrations might be appropriate. Similarly, a recontamination scenario might evaluate a 50 percent reduction in source loads due to various DEQ and other source control programs. In this case, 50 percent of the 95th UCL concentrations might be used. Because of all of the hypothetical situations that could occur when running the Hybrid Model, it is difficult to list every scenario that may or may not be used as an input using the Hybrid Model. Instead, it is easier to determine different loading scenarios as the results of the model runs progress. Stormwater loading scenarios will be further discussed during the QEAFate Calibration Phase.

For the purposes of calibrating the fate model, seven different statistics were chosen in order to represent a full range of different central tendency estimated stormwater loads to the system, due to various ways of calculating the statistics by pooling all of the data together by land use, averaging the data by site, or averaging the data by site and then weighting the data by the amount of runoff from each site. The loads calculated based on these statistics are included in Appendix D, Table D-3. (Note that different loading scenarios were chosen for the RI report but are not further discussed in this document.)

As discussed in Section 5.3.2, for purposes of preliminary calibration runs for the QEAFate model, composite water loads based on statistics averaged by site and then weighted were used, and then these loads were varied in order to determine the sensitivity of the model. This level of variation is generally commensurate with the range of loading estimates obtained by various statistical methods discussed in this report. Composite water and sediment trap based loads are compared in Section 7.4. Further information on loading scenarios will be presented as part of the Hybrid modeling.

7.0 UNCERTAINTY ANALYSIS

Data used to estimate the stormwater composite water loads were collected during a total of 15 storm events, with each outfall sampled an average of three times. Sediment traps were left in place for 3 to 7 months during two separate sampling periods. As previously discussed, due to the limited time span of sampling and the known variability of stormwater, these data should be considered to represent a "snapshot" of stormwater entering the Site during the sampling period. Therefore, there is a general uncertainty regarding the degree to which the results might vary if a different set or several additional "snapshots" had been instead sampled.

The methodology for calculating stormwater loading assumes that concentrations measured in individual sampled outfalls at non-representative locations are indicative of concentrations for all stormwater discharging from a particular non-representative location. This methodology has inherent uncertainty associated with it, because concentrations can vary significantly based on the physical characteristics of the drainage basins associated with the stormwater discharges. For example, if a drainage basin that was sampled drains a known upland source area, the concentrations measured in this discharge will be significantly higher than stormwater discharges at the remainder of the non-representative location. Thus, this example will overestimate stormwater loading for this non-representative location. However, if the drainage basin that was sampled had runoff with lower chemical concentrations than the rest of the site that was not sampled, stormwater loading for the non-representative location would be underestimated.

The uncertainty associated with the runoff volume estimates from the City of Portland BES GRID model is discussed in Appendix B (see Assumptions and Limitations of Analysis discussion).

7.1 RECORDS EXCLUDED FROM LOADING ANALYSIS

Particular records and locations were peremptorily excluded from the working database due to various factors that were identified by the Stormwater Technical Team. There is some general study uncertainty represented by these decisions as compared to including these records in the loading analysis. These outfall locations are shown in Figure 4-2. The following data were not included per discussions with the Stormwater Technical Team and EPA:

- St. Johns Bridge (WR-510) – After the conclusion of Round 3A sampling, the Stormwater Technical Team and EPA discussed that the data from St. Johns Bridge may not be representative of long-term transportation loadings from general highway runoff because the bridge was recently repaired, repaved, and repainted. Therefore, a new location (Hwy 30B) was selected for sampling during Round 3B so there would still be two major transportation locations. These St. Johns Bridge data were not included in the loading calculations as discussed in Section 4.3.4. However, since the major transportation land use represents only 2 percent of the study area, the inclusion or exclusion of these data is not expected to greatly influence the loading estimates. The localized effect of excluding this data will be evaluated during the Hybrid model phase.

- Arkema (WR-96) – Due to insufficient sediment volume collected in sediment traps through both rounds of sampling at WR-96, the Stormwater Technical Team suggested the use of sediment collected from within the outfall structure at this location for sediment sample analysis because there was a large amount of sediment accumulated around the sediment trap bottles. Because this sediment was collected differently from other sampling locations, the "non-representative" loading rates, based on sediment trap data, from this location were not included in the loading rate calculations or discussed in Section 6 and Section 10, and instead the loading estimate from the composite water data was used (as discussed in Section 6.1.1.2. As an example using 4,4' DDT, the basin weighted mean composite water based concentration of 1.66 µg/L with a Geomean TSS of 8.91 mg/L equates to a loading rate of 186,000 µg/kg, which is about 40 percent higher than the sediment trap based loading rate of 120,000 µg/kg. Therefore, loading calculated for WR-96 from composite water samples could be biased high when compared to loading calculated from sediment trap data collected at this location. However, given that composite water data are used for most chemicals for Hybrid modeling, this bias will have no impact on that evaluation.

7.2 COMPARISON OF EXTRAPOLATED TO MEASURED LOADS

As discussed above, not all runoff within the Site was sampled. Rather, locations that were representative of general land use types were sampled and used to extrapolate to other locations, on a land use basis, where runoff was not directly sampled. To provide an estimate of overall uncertainty created by this "representative" method, load values obtained from actual samples at three basins with multiple land uses were compared to the range of calculated loads using the extrapolated land use load method.

These sampled multiple land use basins, as shown in Figure 4-2 include the following locations:

- **OF-18**. OF-18 is an estimated 413-acre basin containing heavy industrial, residential, open space, and major transportation (Hwy 30) land use.
- **OF-19**. OF-19 is a 485-acre basin containing heavy industrial, open space, and major transportation land use.
- **Yeon Mixed Use.** Yeon Mixed Use is an 18-acre sub-basin that drains to the river at OF-18. This basin includes major transportation land use and heavy industrial land use.

Extrapolated loads for each of these basins were calculated using generalized stormwater loading criteria for each land use developed from the stormwater data. For example, the stormwater loading in the Yeon Mixed Use basin could be calculated in two ways:

- Stormwater loading using measured concentrations:

$$L_{Yeon\ Mixed\ Use} = C_w \ x \ V$$

Where:

L = Load (kg/year)

C_w = Measured concentration (µg/L) for Yeon Mixed Use

V = Volume of discharge from land use for 50% flow year.

- Stormwater loading using extrapolated data:

$$L_{\text{Yeon Mixed Use}} = (C_w \text{ x } V)_{\text{heavy industrial}} + (C_w \text{ x } V)_{\text{major transportation}}$$

Where:

L = Load (kg/year)

C_w = Concentration (µg/L) for particular land use

V = Volume of discharge from land use for 50% flow year.

Total PAHs, total PCB congeners, total PCB TEQ – mammalian TEF, total DDx, BEHP, hexachlorobenzene, lead, and mercury were included in this comparative assessment[4]. Loads based on stormwater composite water data and sediment trap data were evaluated. This assessment focused on: 1) whether the measured loading value was within the upper- and lower-bound range of calculated values (defined as the 95th and 5th percentiles, respectively) using the representative method; and 2) the RPD of the measured load and mean representative calculated load. The RPD was calculated as the absolute difference between the measured and mean represented calculated load divided by the average:

$$RPD = \frac{|L_M - \bar{x}_C|}{\left([L_M + \bar{x}_C]\big/2\right)} \times 100$$

Where:

RPD = Relative percent difference

L_m = Measured load

x_c = Mean calculated load

7.2.1 OF-18 Segregation Evaluation

Prior to comparing measured to calculated representative loads for OF-18, an analysis was conducted on the effect of data segregation at this location as a result of the duplicate/replicate analysis performed on composite water data. As a result of this

[4] BEHP and hexachlorobenzene were included in the comparison for sediment trap based loads only.

analysis, nine results were flagged in the data set due to divergence between the normal and duplicate result. The effect of removing these samples on the measured load relative to the calculated loads was assessed to determine the overall effect on the measured load. Graphical analysis of the measured loading values, with and without the segregated data included, to the range of calculated loads was performed for benzo(a)pyrene, lead, PCB-077, PCB-105, PCB-106/118, PCB-126, PCB-156/157, total PCB congeners, and total PCB congener (TEQ) – mammalian 2005 TEFs.

Results of the comparison of loads with and without segregated data to calculated loads for OF-18 are provided in Figure 7-1 and Table 7-1. The "data with segregated data" include the segregated data points. The "data without segregated data" do not include the segregated data points. For all chemicals evaluated, the "data without the segregated data" had lower measured loading values than the "data with the segregated data" loads. For benzo(a)pyrene and lead, both measured values fell above the upper-bound (95th percentile) of the calculated loading values. For PCBs, the "data without the segregated data" loading values fell within the range of calculated loads. Loads measured using "data with the segregated data" exceeded the upper bound calculated load for two PCB congeners, as well as total PCB congeners. Based on this evaluation, the effect of segregating data for OF-18 reduced the loading rates and tended to bring them more in line with calculated loading values. This segregation is also generally consistent with the methods used throughout this study to extrapolate load calculations. Therefore, the results discussed below focus on the analysis using the "data without the segregated data."

7.2.2 Results and Discussion

Results of the comparison between measured and calculated representative loads based on sediment trap data are presented in Table 7-2. In general, measured loads were within the range of calculated loads and were reasonably close to calculated estimates of central tendency (i.e., mean). RPDs between measured loads and mean calculated loads were typically less than 100 percent. OF-18 showed the greatest variability between measured and calculated loads for the chemicals evaluated. Mercury, total PCB congeners, total DDx, BEHP, and hexachlorobenzene had measured loads that exceeded the 95th percentile calculated load and had RPD values exceeding 100 percent on a dry weight basis. Measured loads for mercury, lead, and BEHP exceeded the calculated upper-bound estimate and had RPDs exceeding 100 percent at OF-19. No chemicals met these conditions at Yeon-NW35.[5] However, no measured loads exceeded the upper bound estimate of calculated loads by more than a factor of 4. Measured loading rates only fell below the lower-bound estimate of calculated loads for total DDTs at OF-19.

Comparison of calculated and measured loads using stormwater composite water data is provided in Table 7-3. At OF-18, measured loads exceeded the upper bound calculated load for lead, mercury, and PAHs; however, the RPD only exceeded 100 percent for lead.

[5] Only total PCB congeners and total PCB congeners (TEQ) – mammalian 2005 TEFs were evaluated at this location.

At OF-19 the measured load for lead exceeded the calculated upper bound load but had an RPD of only 84 percent. Finally, the total PCB congeners (TEQ) – mammalian 2005 TEFs measured load at Yeon-NW35 fell below the calculated lower-bound estimate and had an RPD exceeding 100 percent.

Frequently, for composite water data, the range of calculated loads had a relatively small range (often less than a factor of 10), which may account for the measured loads exceeding upper-bound estimates but with relatively low RPDs. In general, measured loads were between the mean and upper bound calculated loads, indicating reasonable agreement between the two methods of determining loads for mixed land use locations. When measured loads did exceed the upper-bound calculated loads, it was by a factor of 2.5 or less. Overall, this comparison appears to indicate that the representative loads are a reasonable estimate of loads from larger mixed land use basins had they been measured in the same general time period. This validates that the representative land use loading method is a reasonable method for estimating loads for the larger study area drainage basin, although a level of uncertainty normally expected for estimating stormwater loads via a variety of methods appears to exist.

7.3 PROCESSED DATA VERSUS UNPROCESSED DATA

As part of the uncertainty analysis, the effect of data processing on the composite stormwater data set used for loading calculations was evaluated. Processing data refers to the steps undertaken to evaluate the composite water and sediment trap data set as discussed in Section 4-3 (i.e., evaluation of duplicates and replicates, reclassification analysis, analysis of high non-detects in sediment trap samples, averaging the samples by site). Specifically, measures of central tendency (i.e., median) and upper-bound estimates (i.e., 95th percentile) of stormwater chemicals were compared on a land-use-specific basis using: 1) the final data set used for loading calculations discussed in this section (hereafter referred to as 'processed data'); and 2) unprocessed data that has not undergone any prior analysis. Processed data used in this analysis are summarized in Appendix D, Table D-2, while unprocessed data are discussed in the RI report. The concept behind this comparison is that the uncertainty associated with a whole series of data processing decisions can be understood by comparing to a method that contains no processing of data. By understanding the overall level of variation of all the processing steps, the general level of uncertainty associated with any particular processing decision can be put in better context. It is important to note that such a comparison has no bearing on what method (processed versus unprocessed) is more technically "correct." It is a relative comparison only.

Table 7-4 provides a side-by-side comparison of processed and unprocessed data set summary statistics for selected stormwater chemicals used in loading calculations. Summary statistics include number of samples, number of detects, frequency of detection, mean, median, and 95th percentile values. In addition, the difference in number of samples in each data set and the percent difference for the mean, median, and 95th percentile were calculated. The percent difference (PD) was calculated as:

$$PD = \frac{(X_U - X_P)}{\left[(X_U + X_P)/2\right]} \times 100$$

Where:

PD = Percent difference

XU = Value of unprocessed data set summary statistic (e.g., mean)

XP = Value of processed data set summary statistic

Larger PD values reflect increasing differences in the statistic of interest between the two data sets. The sign (positive or negative) indicates the direction of the difference. A positive PD indicates that the unprocessed data statistic exceeds the processed data statistic, while a negative value indicates that the processed data set statistic is the larger value.

Figures 7-2 and 7-3 are scatter plots of paired unprocessed versus processed data set median and 95th percentile values, respectively. For these graphs, all stormwater chemicals included in the loading analysis are included. Each symbol represents the paired median or 95th percentile values on a chemical- and land use-specific basis. Symbols are varied to represent the different chemical classes (e.g., metals, PCBs, etc.) included in the scatter plot. Processed data are plotted as the x-axis variable and unprocessed data as the y-axis variable. A line representing a 1:1 relationship (i.e., slope[m] = 1) is included on each graph. Ideally, if there were no differences between data sets, all points on these graphs would fall on this line (i.e., PD = 0). Points that lie to the right of the line indicate that the processed statistic value for that point exceeds the paired unprocessed statistic value (i.e., PD > 1), while points to the left indicate the unprocessed statistic value is greater (i.e., PD < 1).

7.3.1 Results and Discussion

In general, differences between median values in the processed and unprocessed data sets were small. PDs did not exceed 200 percent and infrequently exceeded 100 percent. The greatest variability and highest PD values were observed for pesticides in the light industrial land use classification. These differences are primarily due to low sample count (n = 1 to 6) and the low frequency of detection (0 to 67 percent). Based on Figure 7-2, median values tended to cluster near the 1:1 trendline, indicating relatively low differences in median values. Values did occur more frequently to the right of the trendline, indicating that median values tended to be higher in the processed data set. Variability tends to increase at the lower end of the scatter plot, primarily due to pesticide values near the detection limit and/or low sample counts for these chemicals. Overall, differences are considered relatively low between median values in these data sets. However, this analysis does show that using central tendency estimates may under or overestimate the amount of load from locations where samples were not collected.

As expected, 95th percentile values were generally larger for the unprocessed data set, but not extremely so. All PD values were less than 200 percent, but values above 100 percent were more frequently observed than for the median statistic. Figure 7-3 illustrates this difference. In this plot, values frequently occur to the left of the trendline, indicating that the unprocessed 95th percentile usually exceeded the corresponding processed value. These differences are primarily related to the removal of outliers from the representative data set during the reclassification analysis of stormwater data for loading calculations. Again, pesticides in the light industrial land use showed the greatest variability and PD values, due to the same reasons previously cited for the median value analysis.

In the context of the stormwater loading analysis uncertainty (e.g., modeling, sampling, analysis uncertainties), the uncertainty associated with the stormwater processing on summary statistics for chemical values is considered relatively low. For example, this uncertainty appears to be lower than the uncertainty associated with the representative land use load calculation approach (as compared to measuring concentrations directly) previously discussed. Therefore, it seems very unlikely that much uncertainty is created by any one of the individual processing steps.

7.4 COMPARISON OF SEDIMENT TRAP BASED AND COMPOSITE WATER BASED LOADS

The purpose of this analysis is to compare the calculated annual stormwater loads using the composite water and sediment trap data. These comparisons provide a means to understand the relative uncertainty in the loading estimates used in the model simulations. Estimates of central tendency (e.g., mean and median)[6] stormwater load statistics (e.g., means and percentiles) using composite stormwater and sediment data were compared on a study-area-wide basis to identify any potential differences between loading calculation methods (Figures 7-4a through 7-4g). Comparisons are shown on both a normal and log scale. Analytes included in this analysis were limited to those included in the FS Hybrid Model analysis.

For tri-, tetra-, penta-, hexa-, and hepta-PCB homologs, estimates of central tendency loads based on composite water were higher than similar estimates made using sediment trap data. Differences, however, were generally small and did not exceed an order of magnitude.

For 4,4'-DDT and 4,4-DDE, central tendency loading estimates based on sediment trap data fell within the range of estimates based on composite water data. Two of the central tendency estimates for 4,4'-DDD were lower based on sediment trap results relative to composite water data, but difference were small—less than an order of magnitude.

Central tendency estimates of loads for naphthalene based on sediment trap data were generally lower than for composite water data but overlapped the range of the composite

[6] Descriptions of the estimates of central tendency used in this evaluation are provided in Sections 5.3.2 and 6.3.2

water estimates. Differences were less than an order of magnitude. Benzo(a)pyrene, in contrast, had higher loading estimates based on sediment trap data relative to composite water data. Again, differences were less than an order of magnitude. BEHP had lower loading estimates based on sediment trap relative to composite water data, but again, differences were less than an order of magnitude.

For arsenic, sediment trap based central tendency loading estimates were lower than composite water loads, but differences were less than an order of magnitude. A similar pattern was observed for mercury. For copper, the range of central tendency estimates based on sediment trap data was smaller than for composite water data and fell within the range of composite water loading estimates.

In conclusion, although sediment trap data yielded measures of central tendency for loading estimates that were consistently less (with benzo(a)pyrene being an exception) than those based on composite water data, differences were small—less than order of magnitude. Based on these results, uncertainty in loading estimates based on sediment trap or composite water data is considered low. Consequently, the primary use of composite water-based loads in the Hybrid model is not expected to be a substantial source of uncertainty. Note that, as discussed in Section 5.0 of this report, the composite water-based load represents a total stormwater load in kg/month. In cases where the composite stormwater data was not available to derive a total load (e.g. pesticides and non-representative locations without composite water data), a surrogate composite water value was obtained using the geomean TSS value for the land use or location and the appropriate sediment trap data as explained in Section 5.3.1. Other than these circumstances, the composite stormwater-based load itself sufficiently represents the total stormwater load.

7.4.1 Comparison of Collected TSS Data versus Literature Data

The purpose of this comparison is to evaluate if study collected TSS data is different from TSS data in literature sources to determine if the relatively limited site TSS data set might be unusually high or low as compared to typical values for these land uses. If the site values were very different than literature values, this might indicate a potential source of uncertainty related to using the relatively small TSS data set for loading estimates. Figure 7-5 summarizes TSS data from LWG stormwater sampled in Rounds 3A and 3B. Box plots represent the ranges of LWG data for each land use type. The box plots show overlap between interquartile ranges, indicating considerable overlap between TSS values for each land use. Furthermore, an Analysis of Variance test indicated there was no significant difference in TSS values between land use types ($p = 0.739$). In general, the interquartile range for the Major Transportation and Heavy Industrial were greater than for the other land uses, with the Major Transportation land use having an elevated TSS range of values compared to the other types. Numerous Heavy Industrial TSS values existed outside of the whiskers and would normally be considered outliers. The highest outlier for Heavy Industrial had a value of 2,300 mg/L (not shown) and was sampled from WR-183/Basin R on May 3, 2007.

The data collected by LWG were compared to two literature sources and the mean values from each study are shown in Figure 7-5. DEQ provided stormwater data in early 2008 for sites that had thus far collected data under the JSCS program as discussed in Section 4 of the Draft RI Report (Integral et al. 2009). Additionally, the Oregon Association of Clean Water Agencies (ACWA) has prepared a comparison of TSS concentrations based on land use (Woodward-Clyde 1997). The mean TSS value (124.6 mg/L) provided by DEQ for Heavy Industrial approximates the LWG 75th percentile value for Heavy Industrial while the median DEQ Heavy Industrial value (not shown, 52 mg/L) falls within the interquartile range for Heavy Industrial. ACWA TSS values for other land uses fall within the LWG interquartile range for Residential, Open Space, and Transportation land uses, but are elevated for the Industrial land uses. Note that the ACWA study did not differentiate between Light Industrial and Heavy Industrial; the same mean value (194 mg/L) was used for comparison for both land uses.

Overall, since the study collected data is similar to literature data, using literature data would not have resulted in large differences in stormwater loading estimates and therefore this source of uncertainty is considered relatively insignificant.

7.4.2 Sediment Trap Loading Uncertainty due to Dissolved Metals

Loading values based on sediment trap data do not account for the dissolved fraction of chemicals that may be present in stormwater runoff. It is assumed that this fraction of the chemicals (relative to particulate associated fraction) is negligible. To evaluate the uncertainty in this assumption, the ratio of dissolved to total metals in composite stormwater samples was evaluated. (Note that data were collected for dissolved organics as well, but these data were mainly non-detect, so this evaluation does not include organics.) Figure 7-6 shows scatter plots of the ratio of dissolved to total metals (D/T) versus the total metal concentration on a per sample basis for three metals being modeled with the Hybrid model (arsenic, copper, and zinc). Adjacent to each plot is a second plot showing the relationship between TSS and the total metals concentration for each sample. Several samples have D/T ratios near 1.0, indicating that the metal is predominately present in the dissolved fraction in that sample, particularly at lower metals concentrations. Under such conditions, sediment trap based loads would underestimate the actual loads because of a failure to account for the dissolved fraction. The D/T ratio, however, is generally inversely correlated to the total concentration and also demonstrates a positive correlation with TSS for most metals. This would indicate that under conditions of high TSS and high total metals (which will occur together), the low bias in sediment trap based loads becomes lower.

Thus, during low TSS and low total metals concentration conditions, sediment trap based loading values are likely biased low due to a failure to account for the dissolved metals fraction in the calculation methods. However, during high TSS and high totals metals loading conditions, this low bias generally appears to not be a significant source of uncertainty. Overall, this source of uncertainty is considered relatively insignificant to the overall loading calculations for the site. Also, given that composite water data are used for most chemicals for Hybrid modeling, this bias will have no impact on that evaluation.

7.5 APPLICATION OF NON-REPRESENTATIVE LOADS TO PROPERTIES WHERE ONLY A PORTION OF THE STORMWATER BASINS WERE SAMPLED

Per agreement with EPA and the Stormwater Technical Team, the methodology for calculating stormwater loading assumes that concentrations measured in individual sampled outfalls at non-representative sites are indicative of concentrations for all stormwater discharging from the site. This methodology has inherent uncertainty associated with it, as concentrations can vary significantly based on the physical characteristics of the drainage basins associated with the stormwater discharges. For example, if a drainage basin that was sampled drains a known upland source area, the concentrations measured in this discharge will be significantly higher than stormwater discharges at the remainder of the site. Thus, this example will overestimate stormwater loading for this site. Similarly, if the basin sampled had lower concentrations than the rest of the site, stormwater loading for the site could be underestimated.

In order to understand the possible uncertainty associated with applying the non-representative load to an entire property versus only the sampled basin, three examples were examined where the load to a particular Fate and Transport cell (FT) was calculated in two ways using the unit flows for the FT basin. These examples were selected based on non-representative loads contributing the highest percentage of load to the Study Area for three different chemical groups (PCBs, PAHs, and Pesticides). As shown in Figures 7-7 a-c, the three examples are pentachlorobiphenyl stormwater load to FT37, 4,4 DDT stormwater load to FT20, and benzo(a)pyrene stormwater load to FT34.

First, the load was calculated using the method consistent with loading for non-representative locations as described in Section 4.5 of this report, where the non-representative load is applied to the entire property, as further discussed in Appendix B. Second, the load was calculated with the non-representative load applied to the sampled basin only, and a representative load applied to the remainder of the property. Results of these calculations are shown in Table 7-5. In all cases, applying the non-representative load to the sampled basin only resulted in a reduction of the estimated load to the fate and transport model cell varying from a percent reduction of 91 percent for 4,4 DDT in fate and transport model cell number 20 to a reduction of 31 percent for benzo(a)pyrene in fate and transport model cell number 37. These uncertainties will be accounted for by inputting different ranges of stormwater loading estimates that encompass these uncertainties during the calibration phase of the model, in order to understand the sensitivity of the model to these variations. Although some of the percent reductions for an individual cell appear quite large (e.g., 91 percent per above), it should not be assumed that the overall impact on site wide fate and transport is correspondingly large. The substitution of representative loading rates for parts of a site not sampled could possibly underestimate the overall loading if the site conditions in the sampled and non-sampled drainage basins are similar and higher than the representative loading rate (e.g., it may be reasonable to assume that other drainage basins on the same property as a sampled basin are not consistent with typical heavy industrial representative concentrations but are more consistent with concentrations similar to the sampled basin on the same facility). The sensitivity analysis of stormwater loading for the Hybrid model will help put these loading ranges in perspective and help determine whether they are significant on a site wide (or smaller scale) basis.

8.0 CONCLUSION

This report provides the methods and results to understand the fate and transport of upland stormwater discharges to the Lower Willamette River within the Site. A variety of statistical methods were developed in coordination with the Stormwater Technical Team to provide stormwater loading rate estimates by land use and non-representative location. The loading rates combined together with runoff estimates from the City of Portland's GRID model provide an estimate of the monthly stormwater load to the Site. These stormwater loading evaluation results (included in Appendix D) will be input into the Hybrid fate and transport model to further understanding the relative magnitude of stormwater impacts to the river as compared to other sources at the Site. The final RI will be updated to include changes to the loading estimates that have occurred since the draft RI was submitted.

this is not a report conclusion rather a summary

The stormwater load estimates used for the Hybrid fate and transport model calibration will be discussed as a part of the upcoming QEAFate model calibration check-in with EPA and its partners. The exact application of future stormwater loading scenarios for predictive model runs has not been determined and will be part of the upcoming Hybrid Modeling exercises that will be performed to understand the potential for recontamination and evaluate the long-term outcome of various sediment remediation alternatives evaluated in the FS. Per EPA comments received on August 17, 2010, the loading approach contained herein is acceptable for use in the QEAFate model (EPA 2010).

The findings from the Hybrid modeling efforts will be incorporated into Sections 6 and 10 of the final RI Report, as well as the FS.

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TABLES

Table 3-1. Stormwater Indicator Chemical List

Chemical	RI Empirical Loading, Fate, and Transport Evaluations	FS Hybrid Model Runs for Recontamination and Long-term Alternatives Evaluation
PCBs		
PCB-77	X	X
PCB-81	X	X
PCB-105	X	X
PCB-116/118	X	X
PCB-126	X	X
PCB-156&157	X	X
PCB-169	X	X
PCB Homologs		X
Total PCBs (congeners)	X	
Total PCBs (TEQ) - mammalian 2006 TEFs	X	
DDx		
4,4'-DDD	X	X
4,4'-DDE		X
4,4'-DDT	X	X
Sum DDT	X	
Sum DDE	X	
Sum DDD	X	
Total DDx	X	
PAHs		
Total PAHs	X	
Total Carcinogenic PAHs	X	
Naphthalene	X	X
Benzo(a)pyrene	X	X
SVOCs		
Bis(2-ethylhexyl)phthalate	X	X
Hexachlorobenzene	X	
Pesticides (non DDx)		
Chlordanes (Total)	X	
Gamma – Hexachlorocyclohexane	X	
Aldrin	X	
Dieldrin	X	
Metals		
Arsenic	X	X
Chromium	X	
Copper	X	X
Lead	X	
Mercury	X	X
Nickel	X	
Zinc	X	

Notes:

a - On October 1, 2008 Exec approved the Core Team recommendation of congeners PCB77 and PCB126 for use in the Abiotic Fate & Transport modeling with the understanding that additional congeners, such as 118 and/or others, maybe modeled based upon initial modeling results and EPA input.

Table 3-2. Analytes Measured from Stormwater Samples*

Outfall(s)	Facility or Location	Land Use	TSS	TOC	DOC (filtered)	Total Metals	Diss. Metals (filtered)	PAHs	Phthalates	PCB Congeners	Herbicides	Organo-chlorine Pesticides
Non-Representative Industrial Locations (11)												
WR-22	OSM	Heavy Industrial	X	X	X	X	X	X	X	X	X	
WR-123	Schnitzer International Slip	Heavy Industrial	X	X	X	X	X	X	X	X	X	
WR-384	Schnitzer - Riverside	Heavy Industrial	X	X	X	X	X	X		X	X	
WR-107	GASCO	Heavy Industrial	X	X	X	X	X	X		X	X	
WR-96	Arkema	Heavy Industrial	X	X	X	X	X	X	X	X	X	X
WR-14	Chevron - Transportation	Heavy Industrial	X	X	X	X	X	X		X	X	
WR-161	Portland Shipyard	Heavy Industrial	X	X	X	X	X	X	X	X	X	
WR-4	Sulzer Pump	Heavy Industrial	X	X	X	X	X	X		X	X	
WR-145/142	Gunderson	Heavy Industrial	X	X	X	X	X	X	X	X	X	
WR-147	Gunderson (former Schnitzer)	Heavy Industrial	X	X	X	X	X	X	X	X	X	
Drains to OF-17	GE Decommissioning	Heavy Industrial	X	X	X	X	X	X	X	X		
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Heavy Industrial	X	X	X	X	X	X	X	X		X
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Heavy Industrial	X	X	X	X	X	X	X	X		X
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Heavy Industrial	X	X	X	X	X	X	X	X		X
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Heavy Industrial	X	X	X	X	X	X	X	X		X
Land Use Locations (15)												
WR-67	Siltronic	Heavy Industrial	X	X	X	X	X	X		X	X	
OF-22B	City - Doane Lake Industrial Area	Heavy Industrial[2]	X	X	X	X	X	X		X	X	X
OF-22	City - Willbridge Industrial Area	Heavy Industrial	X	X	X	X	X	X		X	X	
OF-16	City - Heavy Industrial	Heavy Industrial	X	X	X	X	X	X		X	X	
WR-218	UPRR Albina	Heavy Industrial	X	X	X	X	X	X		X	X	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Light Industrial	X	X	X	X	X	X		X	X	
OF-M2	City - Mocks Bottom Industrial Area	Light Industrial	X	X	X	X	X	X	X	X	X	
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Light Industrial	X	X	X	X	X	X	X	X		X
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Light Industrial	X	X	X	X	X	X	X	X		
Hwy 30 "A"	Hwy 30	Major Transportation	X	X	X	X	X	X		X	X	
Hwy 30 "B"[1]	Hwy 30	Major Transportation	X	X	X	X	X	X		X	X	
St. Johns Bridge	Highway drainage	Major Transportation[3]	X	X	X	X	X	X	X	X	X	
OF-22C	City - Forest Park Area	Open Space (Forest Park)	X	X	X	X	X	X	X	X	X	
OF-49	City - St. Johns Area	Residential	X	X	X	X	X	X	X	X	X	
OF-53[T4, COP]	City - Residential above Terminal 4	Residential	X	X	X	X	X	X	X	X		X
Multiple Land Use Locations (3)												
OF-18	City - Multiple Land Uses	Open Space/Heavy Industrial	X	X	X	X	X	X	X	X	X	
OF-19	City - Multiple Land Uses	Open Space/Heavy Industrial	X	X	X	X	X	X		X	X	
Yeon Mixed Use[2]	City - Multiple Land Uses	Major Transportation/Light Industrial	X	X	X	X	X	X		X	X	

Notes:

*An X means that the analyte was measured at least once during the stormwater sampling period, and in most cases three or more times. For more specific information on number of samples collected at each sample location, see the FSR.

1 - The runoff sampled at this location drains to the sanitary sewer overflow bypass tunnel constructed in 2006 and no longer drains to the river.

2 - This site was originally intended to measure Hwy 30 runoff only, however, as discussed in the FSR, the sampling equipment was installed a location where additional drainage from NW 35th was sampled. In order to avoid confusion, this site has been renamed.

T4- Sampled as part of the Port of Portland Terminal 4 Recontamination Study.

COP - Sampled by the City of Portland

Table 3-3. Analytes Measured from Sediment Traps with Detection Limit Factors.*

Outfall(s)	Facility or Location	Land Use	PCB Congeners	TOC	Percent Solids	Organo-chlorine Pesticides	PAHs and Phthalates	Metals	Herbicides
Non- Representative Industrial Locations (11)									
WR-22	OSM	Heavy Industrial	1	1	1	1	1	1	1.3
WR-123	Schnitzer International Slip	Heavy Industrial	1	1	1	1	1	1	1
WR-384	Schnitzer - Riverside	Heavy Industrial	1	1	1	1	1	1	1
WR-107	GASCO	Heavy Industrial	1	1	1	1	1	1	1
WR-96	Arkema	Heavy Industrial	No Measurable Sediment Collected						
WR-14	Chevron - Transportation	Heavy Industrial	1	1	1	1	1	1	1
WR-161	Portland Shipyard	Heavy Industrial	1	1	1	1	1	1	1.4
WR-4	Sulzer Pump	Heavy Industrial	No Sediment Traps Installed						
WR-145/142	Gunderson	Heavy Industrial	1.1	1	1				
WR-147	Gunderson (former Schnitzer)	Heavy Industrial	1	1	1	1	2		
Drains to OF-17	GE Decommissioning	Heavy Industrial	No Sediment Traps Installed						
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Heavy Industrial	1						
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Heavy Industrial	No Sediment Traps Installed						
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Heavy Industrial	1	1	1	1	1	1	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Heavy Industrial	1	1	1	1	1	1	
Land Use Locations (15)									
WR-67	Siltronic	Heavy Industrial	1	1	1	4.8			
OF-22B	City - Doane Lake Industrial Area	Heavy Industrial[2]	1.5	1	1	1	1.5	1	
OF-22	City - Willbridge Industrial Area	Heavy Industrial	1.3	1	1				
OF-16	City - Heavy Industrial	Heavy Industrial	1	1	1	1	1.2		
WR-218	UPRR Albina	Heavy Industrial	1	1	1	1	1	1	1
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Light Industrial	1	1	1	1	1.6		
OF-M2	City - Mocks Bottom Industrial Area	Light Industrial	1	1	1	1	1.6		
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Light Industrial	1	1	1	1	1	1	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Light Industrial	1	1	1		1 (PAHs only)	1	
Hwy 30 "A"	Hwy 30	Major Transportation	1.4	1	1				
Hwy 30 "B"[1]	Hwy 30	Major Transportation	1	1	1	1	1	1	1
St. Johns Bridge	Highway drainage	Major Transportation[3]	1	1	1	1	2.4		
OF-22C	City - Forest Park Area	Open Space (Forest Park)	1	1	1	1	1	1	1
OF-49	City - St. Johns Area	Residential	1	1	1	1	1.8	1	
OF-53[T4, COP]	City - Residential above Terminal 4	Residential	1	1	1	1	1	1	
Multiple Land Use Locations (3)									
OF-18	City - Multiple Land Uses	Open Space/Heavy Industrial	1	1	1	1	1	1	1
OF-19	City - Multiple Land Uses	Open Space/Heavy Industrial	1	1	1	1	1	1	1
Yeon Mixed Use [2]	City - Multiple Land Uses	Major Transportation/Heavy Industrial	1.8	1	1				

Notes:

*Detection limit factor shows how the target detection limit (DL) will be exceeded with the sample mass remaining. A factor of 1 means the target detection limit will be achieved. A factor of 2 means the actual DL will be two times higher than the target DL. Detection Limits are estimated since results of laboratory analysis have not been received.

1 - The runoff sampled at this location drains to the sanitary sewer overflow bypass tunnel constructed in 2006 and no long drains to the river.

2 - This site was originally intended to measure Hwy 30 runoff only, however, as discussed in the FSR, the sampling equipment was installed a location where additional drainage from NW 35th was sampled. In order to aviod confusion, this site has been ren

T4- Sampled as part of the Port of Portland Terminal 4 Recontamination Study.

COP - Sampled by the City of Portland

Table 4-1. Stormwater and Sediment Trap Sampling Locations.

Outfall(s)	Facility or Location	River Mile	Land Use	Industrial or Land Use Activities
Non-Representative Industrial Locations (11)				
WR-22	OSM	2.1	Heavy Industrial	Steel manufacturing
WR-123	Schnitzer International Slip	3.7	Heavy Industrial	Metals
WR-384	Schnitzer - Riverside	4	Heavy Industrial	Metals
WR-107	GASCO	6.4	Heavy Industrial	MGP
WR-96	Arkema	7.3	Heavy Industrial	Chemical manufacturing
WR-14	Chevron - Transportation	7.7	Heavy Industrial	Bulk Fuel
WR-161	Portland Shipyard	8.2	Heavy Industrial	Ship maintenance and repair
WR-4	Sulzer Pump	10.4	Heavy Industrial	Manufacturing
WR-145/142	Gunderson	8.9	Heavy Industrial	Barge and railroad car manufacturing
WR-147	Gunderson (former Schnitzer)	9	Heavy Industrial	Metals handling
Drains to OF-17	GE Decommissioning	9.7	Heavy Industrial	Transformer decommissioning
WR-183/Basin R[T4]	Terminal 4 - Slip 1	4.3	Heavy Industrial	Grains storage/transport
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	4.3	Heavy Industrial	Vacant/former grain storage
WR-177/Basin M[T4]	Terminal 4 - Slip 1	4.3	Heavy Industrial	Car parking/liquid bulk storage
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	4.5	Heavy Industrial	Kinder Morgan bulk storage
Land Use Locations (15)				
WR-67	Siltronic	6.6	Heavy Industrial	Silicon wafer manufacturing
OF-22B	City - Doane Lake Industrial Area	6.9	Heavy Industrial[2]	Chemical manufacturing
OF-22	City - Willbridge Industrial Area	7.7	Heavy Industrial	Petroleum/Forest Park drainage
OF-16	City - Heavy Industrial	9.7	Heavy Industrial	Mixed industrial/highway
WR-218	UPRR Albina	10	Heavy Industrial	Railyard
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Swan Island Lagoon	Light Industrial	Various light industrial uses
OF-M2	City - Mocks Bottom Industrial Area	Swan Island Lagoon	Light Industrial	Trucking and distribution
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	4.3	Light Industrial	Mixed industrial
WR-169/Basin D[T4]	Terminal 4 (Toyota)	4.7	Light Industrial	Vacant/former petroleum storage
Hwy 30 "A"	Hwy 30	9.7	Major Transportation	Highways
Hwy 30 "B"	Hwy 30	n/a[1]	Major Transportation	Highways
St. Johns Bridge	Highway drainage	5.8	Major Transportation[3]	Highways
OF-22C	City - Forest Park Area	6.9	Open Space (Forest Park)	Forest land
OF-49	City - St. Johns Area	6.5	Residential	Local traffic/residential
OF-53[T4,COP]	City - Residential above Terminal 4	5.1	Residential	Local traffic/residential
Multiple Land Use Locations (3)				
OF-18	City - Multiple Land Uses	9.7	Open Space/Heavy Industrial	Also includes highway
OF-19	City - Multiple Land Uses	8.4	Open Space/Heavy Industrial	Also includes highway
Yeon Mixed Use[2]	City - Multiple Land Uses	9.7	Major Transportation/Heavy Industrial	Highways, streets, light industrial

Notes:

1 - The runoff sampled at this location drains to the sanitary sewer overflow bypass tunnel constructed in 2006 and no long drains to the river.

2 - This site was originally intended to measure Hwy 30 runoff only, however, as discussed in the FSR, the sampling equipment was installed a location where additional drainage from NW 35th was sampled. In order to aviod confusion, this site has been renamed.

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COP - Sampled by the City of Portland

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB077	NA	118		86.6		pg/L	0.31	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB126	NA	17	J	7.65	U	pg/L	0.76	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB081	NA	9.12	J	3.86	J	pg/L	0.81	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	1.7	J	0.034	J	pg/L	0.96	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDE	NA	0.018	J	0.049	J	µg/L	0.46	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDT	NA	0.071	U	0.01	NJ	µg/L	0.75	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Dieldrin	NA	0.19		0.089		µg/L	0.72	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	4,4'-DDD	NA	0.079	NJ	0.026	NJ	µg/L	1.01	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Sum DDD	NA	0.079	J	0.026	J	µg/L	0.504761905	YES
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Total DDTs	NA	0.14	J	0.071	J	µg/L	0.327014218	YES
Upper Study Area 1	Albina - UPRR	Heavy Industrial	FD	WR218	11/29/07	LW3-STW2-CW20-WR218	Metals	Arsenic	total	0.7		1.05		µg/L	0.40	YES
							Metals	Arsenic	total	0.72		1.05		µg/L	0.37	YES
Upper Study Area	Highway 30	Transportation	LR	H30B	1/30/08	LW3-STW2-CW50-H30B	Metals	Mercury	dissolved	0.03	J	0.015	U	µg/L	0.67	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PAHs	Benzo(a)pyrene	NA	0.1		0.14		µg/L	0.33	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Chromium	total	7.32		11.5		µg/L	0.44	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB081	NA	16.9	J	8.6	U	pg/L	0.65	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB077	NA	246		573		pg/L	0.80	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB105	NA	1290		7620		pg/L	1.42	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB106 & 118	NA	3190		19100		pg/L	1.43	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Arsenic	total	1.36		1.67		µg/L	0.20	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Lead	total	44.7		76.3		µg/L	0.52	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB126	NA	24.8		110		pg/L	1.26	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB 156&157	NA	525		3200		pg/L	0.72	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCB Congeners	NA	125000	J	503000		pg/L	0.601910828	YES
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	2.6	J	11.4		pg/L	0.628571429	YES
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB077	NA	3.92	J	1.865	U	pg/L	0.71	YES
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB106 & 118	NA	47.3		15.4	U	pg/L	1.02	YES
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCB Congeners	NA	208	J	80.8	J	pg/L	0.440443213	YES
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	0.00096	J	0.00046	J	pg/L	0.352112676	YES
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Tetra	T	3.92	J	25.1	U	µg/L	0.36	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF19	4/9/07	LW3-STW-CW20-OF19	Metals	Mercury	total	0.03	J	0.015	U	µg/L	0.67	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB077	NA	78	J	39.7	J	pg/L	0.65	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB106 & 118	NA	32000	J	317	J	pg/L	1.96	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB126	NA	62.4	J	5.6	UJ	pg/L	1.67	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB105	NA	10200	J	105	J	pg/L	1.96	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB 156&157	NA	2530	J	38	J	pg/L	0.97	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCB Congeners	NA	371000	J	17800	J	pg/L	0.908436214	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	6.7	J	0.009	J	pg/L	0.997317037	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Tri-chlorobiphenyl	total	523.4	J	3906.3	J	pg/L	0.38	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Penta-chlorobiphenyl	total	202108.9	J	3038.8	J	pg/L	0.49	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hexa-chlorobiphenyl	total	135743.4	J	1859.01	J	pg/L	0.49	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hepta-chlorobiphenyl	total	13612.9	J	770.7	J	pg/L	0.45	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	Metals	Lead	total	10.2	J	21.4	J	µg/L	0.71	YES
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	NA	0.011	none	1.1	J	pg/L	0.98019802	
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Nickel	total	2.2		1.71		µg/L	0.25	YES
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Chromium	total	2		1.53		µg/L	0.27	YES
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Arsenic	total	1.75		1.22		µg/L	0.36	YES
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	PCB_Congeners	PCB 156&157	NA	10	J	43.2	J	pg/L	0.62	YES
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2		Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	0.66	J	0.0074	J	pg/L	0.977824393	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	PCB_Congeners	PCB081	NA	9.98	NJ	6.68	NJ	pg/L	0.40	YES
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	Metals	Nickel	total	3.84	J	6.55	J	µg/L	0.52	YES
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	Metals	Nickel	dissolved	1.65	J	1.27	J	µg/L	0.26	YES
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	PCB_Congeners	PCB081	NA	4.1	NJ	1.78	U	pg/L	0.79	YES
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Naphthalene	dissolved	0.014	J	0.019	J	µg/L	0.30	YES
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Benzo(a)pyrene	dissolved	0.018	J	0.03	J	µg/L	0.50	YES
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	Metals	Lead	dissolved	2.69	J	0.843	J	µg/L	1.05	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1 RPD	Decision 1 - RPD > QAPP RPD?
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	11/16/07	WLCT4C07BsnD 071116	PCB_Congeners	PCB156&157	Total	54.9	J	9	J	pg/L	0.72	YES
							Phthalates	Bis(2-ethylhexyl) phthalate	total	1.8		1.1		µg/L	0.48	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Chromium	total	4.65	J	6.38	J	µg/L	0.31	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Nickel	total	4.04	J	7.95	J	µg/L	0.65	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Arsenic	total	0.339	J	0.469	J	µg/L	0.32	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Lead	total	13.7	J	19.2	J	µg/L	0.33	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Mercury	total	0.03	J	0.01	U	µg/L	1.00	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	4,4'-DDT	total	0.015	J	0.0011	UJ	µg/L	1.73	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	Sum DDT	total	0.0027	UJ	0.015	UJ	µg/L	0.694915254	YES
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	Total DDTs	total	0.0054	J	0.015	J	µg/L	0.470588235	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1 RPD	Decision 1 - RPD > QAPP RPD?
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Copper	total	8.94		11.5		µg/L	0.25	YES
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Nickel	total	1.63		2.13		µg/L	0.27	YES
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Chromium	total	0.88		1.86		µg/L	0.72	YES
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Lead	total	7.04		13.8		µg/L	0.65	YES
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	PAHs	Total Carcinogenic PAHs	total	0.0031		0.046		pg/L	0.873727088	YES
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	PAHs	Total PAHs	total	0.26		0.54		pg/L	0.35	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB077	total	154	J	1240	J	pg/L	1.56	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB105	total	707	J	6570	J	pg/L	1.61	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB106 & 118	total	1600	J	15700	J	pg/L	1.63	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB126	total	17.9	J	136	J	pg/L	1.53	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB 156&157	total	260		2730		pg/L	0.83	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	Total PCB Congeners	total	52500	J	594000	J	pg/L	0.837587007	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	1.8	J	14.1	J	pg/L	0.773584906	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Tri-chlorobiphenyl	total	119455.4	J	1195	J	pg/L	0.41	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Tetra-chlorobiphenyl	total	162001	J	15163	J	pg/L	0.41	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Penta-chlorobiphenyl	total	119742.9	J	11142	J	pg/L	0.41	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Hexa-chlorobiphenyl	total	94830.8	J	7412	J	pg/L	0.43	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Hepta-chlorobiphenyl	total	50494	J	3125	j	pg/L	0.44	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	total or dissolved	dup value	dup Qualifiers	N value	N Qualifiers	Units	Decision 1	
															RPD	Decision 1 - RPD > QAPP RPD?
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT 070407	Pesticides	Sum DDD	total	0.0053	J	0.00049	U	µg/L	0.83	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT 070407	Pesticides	Total DDTs	total	0.0071	J	0.0024	UJ	µg/L	0.49	YES
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT 070407	Pesticides	Total Chlordane	total	0.0052	J	0.0012	J	µg/L	0.625	YES
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07Bsn M070503	Pesticides	Sum DDT	total	0.0019	J	0.012	J	µg/L	0.726618705	YES
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07Bsn M070503	Pesticides	Total DDTs	total	0.0048	J	0.014	J	µg/L	0.489361702	YES

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	**Lab Information**	**Decision 2 - Substantial Reason for Divergence?**
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB077	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	--	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB126	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	--	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB081	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	A, E - 105% full, clear with trace sediment in bottom. B,C, D - 105% full, cloudier with more sediment than A.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDE	A - slightly black flocculents in bottom. B-C - clear with earthworm/snails. D-F -cloudy, sediment. G- slightly Cloudy.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDT	A - slightly black flocculents in bottom. B-C - clear with earthworm/snails. D-F -cloudy, sediment. G- slightly Cloudy.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Dieldrin	Sediment, worm, and snail present in stormwater composite sample	--	NO
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	4,4'-DDD	Sediment, worm, and snail present in stormwater composite sample	--	NO
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Sum DDD	Sediment, worm, and snail present in stormwater composite sample	N/A	NO
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Total DDTs	Sediment, worm, and snail present in stormwater composite sample	N/A	NO
Upper Study Area 1	Albina - UPRR	Heavy Industrial	FD	WR218	11/29/07	LW3-STW2-CW20-WR218	Metals	Arsenic	100% full, cloudy, grayish, some sediment.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
							Metals	Arsenic	100% full, cloudy, grayish, some sediment.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
Upper Study Area	Highway 30	Transportation	LR	H30B	1/30/08	LW3-STW2-CW50-H30B	Metals	Mercury	Slight "oil sheen" in some samples.	--	NO. Oil sheen should not affect dissolved mercury concentration.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PAHs	Benzo(a)pyrene	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Benzo(a)pyrene is hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Chromium	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of chromium is more than 50%.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB081	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB077	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB105	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB106 & 118	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Arsenic	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of arsenic is more than 50%.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Lead	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. Particulate fraction of lead is more than 50%.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB126	Some sediment present.	--	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB 156&157	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCB Congeners	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Some sediment present.	N/A	POSSIBLY. Sediment in samples may have affected result. PCB's are hydrophobic, so sediment in one sample and not the other could affect concentrations.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB077	Water is nearly clear with very little suspended material.	--	NO
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB106 & 118	Water is nearly clear with very little suspended material.	--	NO
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCB Congeners	Water is nearly clear with very little suspended material.	N/A	NO
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Water is nearly clear with very little suspended material.	N/A	NO
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Tetra	Water is nearly clear with very little suspended material.		NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF19	4/9/07	LW3-STW-CW20-OF19	Metals	Mercury	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	--	NO
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB077	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB106 & 118	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB126	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB105	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB 156&157	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	Surrogate spike recovery exceedance.	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCB Congeners	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Tri-chlorobiphenyl	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Penta-chlorobiphenyl	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hexa-chlorobiphenyl	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hepta-chlorobiphenyl	100% full, cloudy, light brownish yellow, trace sediment. Also, this sample was possibly contaminanted by a mineral oil spill upstream of the sample.	N/A	POSSIBLY. Sediment in sample may have affected concentrations. Samples were composited in lab with glass carboy and mixed with a magnetic stir stick. Field duplicates were collected after all Parent samples had been collected. It could be expected that more sediment was present near the bottom of a sample, and that sediment could effect the concentration of PCB's since PCB's are hydrophobic.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	Metals	Lead	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO. Slight sediment is not expected to impact the sample concentrations.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	N/A	
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Nickel	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other nickel samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Chromium	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other chromium samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Arsenic	A-G - 100% full, yellowish, slight (A-D) to very slight (EG) sediment and very slightly turbid (E-G)	--	POSSIBLY. No dissolved information available for this date, but in other arsenic samples at OFM2 the particulate fraction was more than 50% so sediment may have affected sample.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	PCB_Congeners	PCB 156&157	A - opaque orange, trace orange silt on bottom, trace pollen. B-H - clear-orange, trace sand and silt on base, trace pollen, clears in D, cloudy again in E-H.	N/A	NO
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	A - opaque orange, trace orange silt on bottom, trace pollen. B-H - clear-orange, trace sand and silt on base, trace pollen, clears in D, cloudy again in E-H.	N/A	NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	PCB_Congeners	PCB081	No field data regarding visible observations of sample available.	Analyte did not meet all identification criteria.	NO
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	Metals	Nickel		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	Metals	Nickel	No field data regarding visible observations of sample available.	Matrix spike recovery exceedance, replicate precision, or internal standard performance. Also, dissolved concentration is higher than total concentration in both cases.	YES. Dissolved concentration should not be more than total concentration.
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	PCB_Congeners	PCB081		--	NO
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Naphthalene	No field data regarding visible observations of sample available.	Surrogate spike recovery exceedance.	NO
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Benzo(a)pyrene		Surrogate spike recovery exceedance.	NO
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	Metals	Lead		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	11/16/07	WLCT4C07BsnD 071116	PCB_Congeners	PCB156&157	No field data regarding visible observations of sample available.	--	NO
							Phthalates	Bis(2-ethylhexyl) phthalate		--	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Chromium	No field data regarding visible observations of sample available.	Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Nickel		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Arsenic		Matrix spike recovery exceedance, replicate precision, or internal standard performance	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Lead		Matrix spike recovery exceedance, replicate precision, or internal standard performance.	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Metals	Mercury		Qualified because the value is between the MDL and MRL.	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	4,4'-DDT		Continuing calibration blank exceedances.	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	Sum DDT		N/A	NO
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ 070324	Pesticides	Total DDTs		N/A	NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Copper	No field data regarding visible observations of sample available.	--	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Nickel		--	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Chromium		--	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	Metals	Lead		--	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	PAHs	Total Carcinogenic PAHs		N/A	NO
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR 071116	PAHs	Total PAHs		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB077	No field data regarding visible observations of sample available.	Surrogate spike recovery exceedance.	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB105		Surrogate spike recovery exceedance.	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB106 & 118		Surrogate spike recovery exceedance.	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB126		Surrogate spike recovery exceedance.	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	PCB 156&157		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	Total PCB Congeners		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Tri-chlorobiphenyl		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Tetra-chlorobiphenyl		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Penta-chlorobiphenyl		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Hexa-chlorobiphenyl		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT 070503	PCB_Homologs	Hepta-chlorobiphenyl		N/A	NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 2		
									Field Notes	Lab Information	Decision 2 - Substantial Reason for Divergence?
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Sum DDD	No field data regarding visible observations of sample available.	N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Total DDTs		N/A	NO
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Total Chlordane		N/A	NO
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07BsnM070503	Pesticides	Sum DDT	No field data regarding visible observations of sample available.	N/A	NO
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07BsnM070503	Pesticides	Total DDTs		N/A	NO

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB077	Both samples within Interquartile Range.	YES	10	NO	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB126	Both samples within Interquartile Range. Also note that the detection limit for the Parent sample is 15.3 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 17.	YES	10	YES	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	PCB081	Parent sample within Interquartile Range, FD within higher part of range.	YES	10	YES	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	11/27/07	LW3-STW2-CW20-OF22B	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs.	Both samples are within range.	YES	N/A	N/A	Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDE	Both samples are within range.	YES	0.0005	NO	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	5/3/07	LW3-STW-CW20-OF22B	Pesticides	Sum DDT	The FD is higher than the range, but it is a non-detect.	NO	0.0005	NO	Segregate the FD, keep the parent.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Dieldrin	Yes, within range of other samples from OF22B (Unique for Pesticides).	YES	0.0005	NO	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	4,4'-DDD	The Parent sample is barely below the range of the other three samples from OF22B (Unique for Pesticides) and the FD is within the range. Entire range of samples spans between 0.02 and 0.16.	YES	0.0005	NO	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Sum DDD	The Parent sample is barely below the range of the other three samples from OF22B (Unique for Pesticides) and the FD is within the range.	YES	0.0005	NO	Average the two samples.
Upper ISA	City - Doane Lake Industrial Area	Heavy Industrial	FD	OF22B	3/27/07	LW3-STW-CW10-OF22B	Pesticides	Total DDTs	Both samples are within range.	YES	0.0005	NO	Average the two samples.
Upper Study Area 1	Albina - UPRR	Heavy Industrial	FD	WR218	11/29/07	LW3-STW2-CW20-WR218	Metals	Arsenic	Both samples within Interquartile Range.	YES	0.05	NO	Average the two samples.
							Metals	Arsenic	Both samples within Interquartile Range.	YES	0.05	NO	Average the two samples.
Upper Study Area	Highway 30	Transportation	LR	H30B	1/30/08	LW3-STW2-CW50-H30B	Metals	Mercury	YES (only three other samples). Also note that the detection limit for the Parent sample was 0.03 which matches the LR, but is shown here at half the detection limit for calculating RPD.	YES	0.2	YES	Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PAHs	Benzo(a)pyrene	No, the Parent sample is above the range of the other samples, and the FD is within the higher part of the range for OF18. However, the entire range of all samples only spans between 0.03 and 0.14.	NO	0.02	NO	Segregate the Parent sample, keep FD.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Chromium	YES, both samples are within range (only four other samples).	YES	0.2	NO	Average the two samples.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB081	No. These two samples are both higher than the other samples from OF18. However, the entire range of samples only spans between 2 and 16.8 and one of the samples is a non-detect. Also note that the detection limit for the Parent sample is 15.2 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 16.9.	NO	10	YES	Average the two samples.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB077	The FD is within the range, the Parent sample is outside of the range of the other OF18 samples. The entire range of samples spans between 150 and 600.	NO	10	NO	Segregate Parent sample, keep FD.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB105	The FD is very close to the higher part of the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 100 and 8000.	NO	10	NO	Segregate Parent sample, keep FD.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB106 & 118	The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 500 and 19100.	NO	10	NO	Segregate Parent sample, keep FD.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Arsenic	Yes, they are both within the range.	YES	0.05	NO	Average the two samples.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	Metals	Lead	The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 8 and 80.	NO	0.02	NO	Segregate Parent sample, keep FD.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB126	The FD is within the range, the Parent sample is outside of the range of other OF18 samples. The entire range of samples spans between 5 and 100.	NO	10	NO	Segregate Parent sample, keep FD.
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	PCB 156&157	Both samples are higher than the other two samples from OF18.	NO	10	NO	Segregate both samples
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCB Congeners	Both samples are higher than the other two samples from OF18.	NO	10	NO	Segregate both samples
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF18	3/26/07	LW3-STW-CW10-OF18	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	The FD is within the range, the Parent is outside of the range of the other OF18 samples. The entire range of samples spans between 2.5 and 2.6	NO	N/A	N/A	Segregate Parent sample, keep FD.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB077	Parent sample is lower than range, FD is higher than range. Also, note that the detection limit for the Parent sample is 3.73 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 3.92.	NO	10	YES	Average the two samples.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	PCB106 & 118	Parent sample is within range, FD is slightly higher, but only three other samples. Also note that the detection limit for the Parent sample is 30.8 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 47.3.	YES	10	YES	BPJ. Average the two samples.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCB Congeners	Only one other sample.	N/A	NO	NO	BPJ. Average the two samples.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Only one other sample.	N/A	N/A	N/A	BPJ. Average the two samples.
Middle ISA	City - Above Hwy 30, Forest Park Area	Open Space	FD	OF22C	4/18/07	LW3-STW-CW10-OF22C	PCB_Congeners	Tetra	FD is lower than range, but only two other samples.	NO	10	YES	BPJ. Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Multiple Land Uses	Multiple Land Uses	FD	OF19	4/9/07	LW3-STW-CW20-OF19	Metals	Mercury	FD is within Interquartile Range, Parent sample is within lower part of range. Also note that the detection limit for the Parent sample was 0.03 which matches the FD, but is shown here at 1/2 detection limit for calculating RPD.	YES	0.2	YES	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB077	Parent sample is within Interquartile Range, LR is in higher part of range.	YES	10	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB106 & 118	Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB126	Parent sample is within range, LR is much higher than range.	NO	10	YES	Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3: Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4: Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB105	Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	PCB 156&157	Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCB Congeners	Parent sample is within range, LR is much higher than range.	NO	10	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Parent sample is within range, LR is much higher than range.	NO	N/A	N/A	Segregate the LR, keep Parent.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3: Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4: Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Tri-chlorobiphenyl	Yes, both samples are within range	YES	N/A	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Penta-chlorobiphenyl	Parent sample is within range, LR is much higher than range.	NO	N/A	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hexa-chlorobiphenyl	Parent sample is within range, LR is much higher than range.	NO	N/A	NO	Segregate the LR, keep Parent.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/9/07	LW3-STW-CW20-OFM1	PCB_Homologs	Hepta-chlorobiphenyl	Parent sample is within range, LR is much higher than range.	NO	N/A	NO	Segregate the LR, keep Parent.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3		Decision 4		FINAL RECOMMENDATION
									Within Range of Land Use?	Decision 3 - Are samples within land use range?	MRL	Decision 4 - < 2X MRL?	
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	Metals	Lead	Parent sample within higher part of range, LR within Interquartile Range.	YES	0.02	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	LR	OFM1	4/18/07	LW3-STW-CW30-OFM1	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Both samples are within range.	YES	N/A	N/A	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Nickel	Both samples within Interquartile Range.	YES	0.2	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Chromium	Parent sample within lower part of range, FD within Interquartile Range.	YES	0.2	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	4/23/07	LW3-STW-CW30-OFM2	Metals	Arsenic	Both samples within higher part of range.	YES	0.05	NO	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2	PCB_Congeners	PCB 156&157	Both samples are within range.	YES	10	YES	Average the two samples.
Upper ISA	City - Mocks Bottom	Light Industrial	FD	OFM2	5/3/07	LW3-STW-CW40-OFM2		Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Both samples are within range.	YES	N/A	N/A	Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3: Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4: Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	PCB_Congeners	PCB081	Yes, both samples are within the range of other MH2 samples.	YES	10	YES	Average the two samples.
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	10/19/07	WLCGED07MH2SW101907U	Metals	Nickel	FD within Interquartile Range, Parent sample within higher part of range.	YES	0.2	NO	Average the two samples.
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	Metals	Nickel	Both samples within Interquartile Range.	YES	0.2	NO	Segregate the two samples.
Upper Study Area	GE Decommissioning Facility	Heavy Industrial	FD	Manhole 2	11/13/07	WLCGED07MH2SW111307F	PCB_Congeners	PCB081	Yes, both samples are within the range of other MH2 samples (Unique for PCBs). Also note that the detection limit for the Parent sample is 3.56 (shown at half the detection limit for calculating RPD), which is very close to the FD value of 4.1.	YES	10	YES	Average the two samples.
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Naphthalene	No, both samples lower than range, but only two other samples (Unique for PAHs). The entire range spans between 0.010 and 0.035.	NO	0.02	YES	Average the two samples.
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	PAHs	Benzo(a)pyrene	FD is within range, Parent sample higher than range, but only two other samples (Unique for PAHs). The entire range spans between 0.01 and 0.03.	NO	0.02	YES	Average the two samples.
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	5/3/07	WLCT4C07BsnD070503	Metals	Lead	Both samples higher than range, but only three other samples (Unique for metals). The entire range spans between 0.16 and 2.8. Also, the total lead in both samples were the two highest total lead concentrations for this sample location (around 40).	NO	0.02	NO	BPJ. Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Lower ISA	Basin D Terminal 4 (Toyota) WR-169	Light Industrial	FD	Basin D	11/16/07	WLCT4C07BsnD071116	PCB_Congeners	PCB156&157	Both samples within range.	YES	10	YES	Average the two samples.
							Phthalates	Bis(2-ethylhexyl) phthalate	Parent sample within lower part of range, FD within Interquartile Range.	YES	0.5	NO	Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Chromium	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.2	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Nickel	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.2	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Arsenic	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.05	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Lead	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals).	N/A	0.02	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Metals	Mercury	Only one other sample other than the Parent sample and FD, therefore determining a range of values was not possible. (Unique for metals). Additionally, one of the samples is a non-detect. Also note that the detection limit for the Parent sample is 0.02 (shown at half the detection limit for calculating RPD) , which is very close to the FD value of 0.03.	N/A	0.2	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Pesticides	4,4'-DDT	Parent sample within lower part of range, FD barely higher than range. Also, one of the samples is a non-detect.	YES	0.0005	NO	BPJ. Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Pesticides	Sum DDT	Both samples are within range.	YES	0.0005	NO	Average the two samples.
Lower ISA	Basin Q Terminal 4 Slip 1 WR-181	Heavy Industrial	FD	Basin Q	3/24/07	WLCT4C07BsnQ070324	Pesticides	Total DDTs	Both samples are within range.	YES	0.0005	NO	Average the two samples.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Metals	Copper	Both samples within lower part of range.	YES	0.1	NO	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Metals	Nickel	Both samples within lower part of range.	YES	0.2	NO	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Metals	Chromium	Parent sample within Interquartile Range, FD within lower part of range.	YES	0.2	NO	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	Metals	Lead	Both samples within Interquartile Range.	YES	0.02	NO	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	PAHs	Total Carcinogenic PAHs	Both samples are within range.	YES	N/A	N/A	Average the two samples.
Lower ISA	Basin R Terminal 4 Slip 1 WR-183	Heavy Industrial	FD	Basin R	11/16/07	WLCT4C07BsnR071116	PAHs	Total PAHs	Both samples are within range.	YES	0.02	NO	Average the two samples.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	PCB077	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	PCB105	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	PCB106 & 118	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	PCB126	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	PCB 156&157	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	Total PCB Congeners	Parent sample is higher than range, FD is within higher part of range.	NO	10	NO	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Congeners	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Homologs	Tri-chlorobiphenyl	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Homologs	Tetra-chlorobiphenyl	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Homologs	Penta-chlorobiphenyl	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Homologs	Hexa-chlorobiphenyl	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	5/3/07	WLCT4C07BsnT070503	PCB_Homologs	Hepta-chlorobiphenyl	Parent sample is higher than range, FD is within higher part of range.	NO	N/A	N/A	Segregate the Parent sample, keep FD.

Table 4-2. Duplicate/Replicate Outliers in Composite Stormwater Samples.

River Reach	Site	Land Use	Sample Type	Location Name	Sample Date	parent_sample_code	Analyte Group	Analyte	Decision 3: Within Range of Land Use?	Decision 3: Decision 3 - Are samples within land use range?	Decision 4: MRL	Decision 4: Decision 4 - < 2X MRL?	FINAL RECOMMENDATION
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Sum DDD	Parent sample is lower than range but is non detect, FD is within range.	NO	0.0005	NO	BPJ. Average the two samples.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Total DDTs	Both samples are within range.	YES	0.0005	NO	Average the two samples.
Lower ISA	Basin T Terminal 4 OF52C	Light Industrial	FD	Basin T	4/7/07	WLCT4C07BsnT070407	Pesticides	Total Chlordane	Parent sample is barely outside of range on low end but only two other samples. FD is outside of range.	NO	0.0005	NO	BPJ. Average the two samples.
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07BsnM070503	Pesticides	Sum DDT	Both samples are within range.	YES	0.0005	NO	Average the two samples.
Lower ISA	Basin M Terminal 4 WR-177	Heavy Industrial	FD	Basin M	5/3/07	WLCT4C07BsnM070503	Pesticides	Total DDTs	Both samples are within range.	YES	0.0005	NO	Average the two samples.

Table 4-3. Chemicals and Sites for Further Analysis

Outfall #	Facility/Location	Non-Representative Chemicals for Further Analysis
WR-22	OSM	PCBs, PAHs, metals
WR-123	Schnitzer International Slip	PCBs, phthalates, metals
WR-384	Schnitzer - Riverside	Metals, PCBs
WR-107	GASCO	PAHs
WR-96	Arkema	Pesticides
WR-14	Chevron - Transportation	PAHs
WR-161	Portland Shipyard	PAHs, phthalates, metals, PCBs
WR-4	Sulzer Pump	PAHs, metals, PCBs
WR-145	Gunderson	PCBs, PAHs, phthalates, metals
WR-147/148	Gunderson (former Schnitzer)	Phthalates, metals, PCBs, PAHs
Drains to OF-17	GE	PCBs
WR-183/Basin R^{T4}	Terminal 4 - Slip 1	PAHs, TOC
WR-181/Basin Q^{T4}	Terminal 4 - Slip 1	Metals, PAHs, TOC
WR-177/Basin M^{T4}	Terminal 4 - Slip 1	Metals, PAHs
WR-169/Basin D^{T4}	Terminal 4	Metals, PAHs
WR-20/Basin L^{T4}	Terminal 4 - Wheeler Bay	PAHs
OF-22B	City –Doane Lake Industrial Area	Pesticides, Metals
WR-510	St. John's Bridge/Highway 30	PCBs, others (bridge repaving activity)

Notes:
T4- Sampled as part of the Port of Portland Terminal 4 Recontamination Study.

Table 4-4a. Reclassification Summary for PAHs

Outfall(s)	Facility or Location	A priori Classificaton	Benzo(a)pyrene			Naphthalene		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
WR-107	GASCO	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-14	Chevron - Transportation	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Table 4-4a. Reclassification Summary for PAHs

Outfall(s)	Facility or Location	A priori Classificaton	Total cPAHs PaBEq			Total PAHs		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
WR-107	GASCO	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-14	Chevron - Transportation	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report

Table 4-4b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classificaton	PCB 077		PCB 081		PCB 105	
			Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Heavy Industrial								
Manhole 2	GE Decommissioning	Non-representative		Representative		Representative		Representative
WR-123	Schnitzer International Slip	Non-representative		Representative		Representative		Representative
WR-142/145	Gunderson	Non-representative		Representative		Representative		Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative		Representative		Representative
WR-161	Portland Shipyard	Non-representative		Representative		Representative		Representative
WR-22	OSM	Non-representative		Representative		Representative		Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative		Non-representative		Non-representative
WR-4	Sulzer Pump	Non-representative		Representative		Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative		Representative	
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative		Representative	
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative		Representative	
WR-107	GASCO	Representative	Representative		Representative		Representative	
WR-14	Chevron - Transportation	Representative	Representative		Representative		Representative	
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Non-Representative[1]		Representative	
WR-218	UPRR Albina	Representative	Representative		Representative		Representative	
WR-67	Siltronic	Representative	Representative		Representative		Representative	
WR-96	Arkema	Representative	Representative		Representative		Representative	
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative		Representative	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative		Representative	

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site-specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

3. Note that the reclassification analysis was not performed for the individual homologs since they would follow the same classification as for Total PCBs and the individual PCB congeners.

Table 4-4b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classificaton	PCB 106 + 118		PCB 126		PCB 156+157	
			Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Heavy Industrial								
Manhole 2	GE Decommissioning	Non-representative		Representative		Representative		Representative
WR-123	Schnitzer International Slip	Non-representative		Representative		Representative		Representative
WR-142/145	Gunderson	Non-representative		Representative		Representative		Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative		Representative		Representative
WR-161	Portland Shipyard	Non-representative		Representative		Representative		Representative
WR-22	OSM	Non-representative		Representative		Representative		Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative		Non-representative		Non-representative
WR-4	Sulzer Pump	Non-representative		Representative		Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative		Representative	
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative		Representative	
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative		Representative	
WR-107	GASCO	Representative	Representative		Representative		Representative	
WR-14	Chevron - Transportation	Representative	Representative		Representative		Representative	
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative		Representative	
WR-218	UPRR Albina	Representative	Representative		Representative		Representative	
WR-67	Siltronic	Representative	Representative		Representative		Representative	
WR-96	Arkema	Representative	Representative		Representative		Representative	
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative		Representative	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative		Representative	

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site-specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

3. Note that the reclassification analysis was not performed for the individual homologs since they would follow the same classification as for Total PCBs and the individual PCB congeners.

Table 4-4b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classificaton	PCB 169		Total PCBs		Total PCBs TEQ	
			Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Heavy Industrial								
Manhole 2	GE Decommissioning	Non-representative		Representative		Representative		Representative
WR-123	Schnitzer International Slip	Non-representative		Representative		Representative		Representative
WR-142/145	Gunderson	Non-representative		Representative		Representative		Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Non-Representative[2]		Representative		Representative
WR-161	Portland Shipyard	Non-representative		Representative		Representative		Representative
WR-22	OSM	Non-representative		Representative		Representative		Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative		Non-representative		Non-representative
WR-4	Sulzer Pump	Non-representative		Representative		Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative		Representative	
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative		Representative	
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative		Representative	
WR-107	GASCO	Representative	Representative		Representative		Representative	
WR-14	Chevron - Transportation	Representative	Representative		Representative		Representative	
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative		Representative	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative		Representative	
WR-218	UPRR Albina	Representative	Representative		Representative		Representative	
WR-67	Siltronic	Representative	Representative		Representative		Representative	
WR-96	Arkema	Representative	Representative		Representative		Representative	
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative		Representative	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative		Representative	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative		Representative	

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site-specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

3. Note that the reclassification analysis was not performed for the individual homologs since they would follow the same classification as for Total PCBs and the individual PCB congeners.

Table 4-4b. Reclassification Summary for PCBs

Outfall(s)	Facility or Location	A priori Classificaton	PCB Homologs		All PCBs
			Step 1	Step 2	Final
Heavy Industrial					
Manhole 2	GE Decommissioning	Non-representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative

Notes:

T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site-specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

1. For Basin L, two out of four samples are Non-representative for PCB 081, however that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

2. For WR-147, some of the samples for PCB 156+157 are outside of the representative range. However, that site is not Non-representative for any other congener or total PCBs, so the classification remains Representative.

3. Note that the reclassification analysis was not performed for the individual homologs since they would follow the same classification as for Total PCBs and the individual PCB congeners.

Table 4-4c. Reclassification Summary for Phthalates

Outfall(s)	Facility or Location	A priori Classificaton	Bis(2-ethylhexyl) phthalate		
			Step 1	Step 2	Final
Heavy Industrial					
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Non-representative	Non-representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC
OF-22B	City - Doane Lake Industrial Area	Representative	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Non-representative	Non-representative	Non-representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	NSC		NSC
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classificaton	Arsenic			Chromium		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-384	Schnitzer - Riverside	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 4-4d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classificaton	Copper			Lead		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-161	Portland Shipyard	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 4-4d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classificaton	Mercury			Nickel		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Representative	Representative		Representative	Representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Representative	Representative		Representative	Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative	Representative		Representative
WR-96	Arkema	Representative	Non-representative	Non-representative	Non-representative	Representative		Representative
Light Industrial								
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 4-4d. Reclassification Summary for Metals

Outfall(s)	Facility or Location	A priori Classificaton	Zinc		
			Step 1	Step 2	Final
Heavy Industrial					
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative
WR-123	Schnitzer International Slip	Non-representative		Representative	Representative
WR-142/145	Gunderson	Non-representative		Non-representative	Non-representative
WR-147	Gunderson (former Schnitzer)	Non-representative		Representative	Representative
WR-161	Portland Shipyard	Non-representative		Non-representative	Non-representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-22	OSM	Non-representative		Representative	Representative
WR-384	Schnitzer - Riverside	Non-representative		Non-representative	Non-representative
WR-4	Sulzer Pump	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Non-representative	Non-representative	Non-representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Non-representative		Representative	Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
Site specific notes from T4 come from Appendix C, Attachment C-1 of Loading Methods Report

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton	4,4'-DDD			4,4'-DDE			4,4'-DDT	
			Step 1	Step 2	Final	Step 1	Step 2	Final	Step 1	Step 2
Heavy Industrial										
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative		Non-representative
WR-96	Arkema	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative		Non-representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC	NSC	
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative	Representative	
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC	NSC	
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative	Representative	
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative	Representative	
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative	Representative	
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC	NSC	
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Representative		Representative	Representative	
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative	Representative	
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative	
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative	
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative	Representative	
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative	Representative	
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative	Representative	
WR-22	OSM	Representative	Representative		Representative	Representative		Representative	Representative	
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative	Representative	
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC	NSC	
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC	NSC	
Light Industrial										
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative	
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative	
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative	Representative	
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC	NSC	

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton		Aldrin		
			Final	Step 1	Step 2	Final
Heavy Industrial						
OF-22B	City - Doane Lake Industrial Area	Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC	NSC		NSC
WR-107	GASCO	Representative	Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative	Representative		Representative
WR-22	OSM	Representative	Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC	NSC		NSC
Light Industrial						
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton	Dieldrin			gamma-Hexachlorocyclohexane		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative		Non-representative	Non-representative		Representative	Representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton	Hexachlorobenzene			Total Chlordanes		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Representative	Representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative		Representative	Representative		Non-representative	Non-representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Non-representative	Non-representative	Non-representative
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton	Sum DDD			Sum DDE		
			Step 1	Step 2	Final	Step 1	Step 2	Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4e. Reclassification Summary for Pesticides

Outfall(s)	Facility or Location	A priori Classificaton	Sum DDT Step 1	Sum DDT Step 2	Sum DDT Final	Total DDXs Step 1	Total DDXs Step 2	Total DDXs Final
Heavy Industrial								
OF-22B	City - Doane Lake Industrial Area	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
WR-96	Arkema	Non-representative		Non-representative	Non-representative		Non-representative	Non-representative
Manhole 2	GE Decommissioning	Representative	NSC		NSC	NSC		NSC
OF-16	City - Heavy Industrial	Representative	Representative		Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	NSC		NSC	NSC		NSC
WR-107	GASCO	Representative	Representative		Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative	Representative		Representative
WR-142/145	Gunderson	Representative	NSC		NSC	NSC		NSC
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative	Representative		Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	NSC		NSC	NSC		NSC
WR-67	Siltronic	Representative	NSC		NSC	NSC		NSC
Light Industrial								
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative	Representative		Representative
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	NSC		NSC	NSC		NSC

Notes:
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
NSC - No samples collected

Table 4-4f. Reclassification Summary for Total Organic Carbon

Outfall(s)	Facility or Location	A priori Classificaton	Total Organic Carbon		
			Step 1	Step 2	Final
Heavy Industrial					
WR-181/Basin Q[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-183/Basin R[T4]	Terminal 4 - Slip 1	Non-representative		Representative	Representative
WR-20/Basin L[T4]	Terminal 4 - Wheeler Bay	Representative	Representative		Representative
WR-177/Basin M[T4]	Terminal 4 - Slip 1	Representative	Representative		Representative
Manhole 2	GE Decommissioning	Representative	Representative		Representative
OF-16	City - Heavy Industrial	Representative	Representative		Representative
OF-22	City - Willbridge Industrial Area	Representative	Representative		Representative
OF-22B	City - Doane Lake Industrial Area	Representative	Representative		Representative
WR-107	GASCO	Representative	Representative		Representative
WR-123	Schnitzer International Slip	Representative	Representative		Representative
WR-14	Chevron - Transportation	Representative	Representative		Representative
WR-142/145	Gunderson	Representative	Representative		Representative
WR-147	Gunderson (former Schnitzer)	Representative	Representative		Representative
WR-161	Portland Shipyard	Representative	Representative		Representative
WR-218	UPRR Albina	Representative	Representative		Representative
WR-22	OSM	Representative	Representative		Representative
WR-384	Schnitzer - Riverside	Representative	Representative		Representative
WR-4	Sulzer Pump	Representative	Representative		Representative
WR-67	Siltronic	Representative	Representative		Representative
WR-96	Arkema	Representative	Representative		Representative
Light Industrial					
WR-169/Basin D[T4]	Terminal 4 (Toyota)	Representative	Representative		Representative
OF-52C/Basin T[T4]	City - Terminal 4 Industrial Area	Representative	Representative		Representative
OF-M1, above Devine	City - Mocks Bottom Industrial Area	Representative	Representative		Representative
OF-M2	City - Mocks Bottom Industrial Area	Representative	Representative		Representative

Notes:
iCOCs per iAOPC referenced from Table 10.5-1 of the Round 2 Report
T4 - Sampled as part of the Port of Portland Terminal 4 Recontamination
NSC - No samples collected

Table 4-5. Summary of Non-Representative Locations by Analyte

Analyte	Non-Representative Locations				
Metals					
Arsenic	Manhole 2[1,2]	WR-96[1,3]			
Chromium	Basin R[1]	WR-123	WR-22	WR-384	
Copper	Basin R[1]	WR-142/145[1]	WR-147[1]	WR-161	WR-384
Lead	Basin R[1]	OF-22B	WR-147[1]	WR-384	
Mercury	Basin R[1]	OF-22B	WR-384	WR-96[3]	
Nickel	Basin R[1]	WR-384			
Zinc	Basin R[1]	WR-142/145[1]	WR-161	WR-384	
PCBs					
PCB077	WR-384				
PCB081	WR-384				
PCB105	WR-384				
PCB118	WR-384				
PCB126	WR-384				
PCB156 & PCB157	WR-384				
PCB169	WR-384[2]				
Total PCBs	WR-384				
PCB Homologs	WR-384				
PCB TEQ	WR-384				
Pesticides					
4,4'-DDD	OF-22B	WR-96[3]			
4,4'-DDT	OF-22B	WR-96[3]			
Total of 2,4'- and 4,4'-DDE	OF-22B	WR-96[3]			
Total of 2,4'- and 4,4'-DDD	OF-22B	WR-96[3]			
Total of 2,4'- and 4,4'-DDT	OF-22B	WR-96[3]			
Total DDX	OF-22B	WR-96[3]			
Total Chlordanes	OF-22B	WR-147[4]	WR-96[2,3]		
γ-Hexachlorocyclohexane	OF-22B				
Hexachlorobenzene					
Aldrin	OF-22B				
Dieldrin	OF-22B	WR-96[2,3]			
PAHs					
Naphthalene					
Benzo(a)pyrene	Basin L	WR-107	WR-14	WR-384	
Total Carcinogenic PAHs	Basin L	WR-107	WR-14	WR-384	
Total PAHs	Basin L	WR-384			
Phthalates					
Bis(2-ethylhexyl)phthalate	Basin L	WR-142/145[1]			

Notes:

1 - Sediment trap samples not collected or available.

2 - Location excluded from loading totals because although the location was classified as Non-Representative, all composite water and sediment samples were non-detect.

3 - Sediment trap samples excluded from analysis because sample was from catch basin solids as opposed to in-line sediment samples. This location will be addressed during uncertainty analysis.

4 - Composite water samples not collected or available.

Table 4-6. St. Johns Bridge Sediment Trap Data versus Major Transportation Sediment Trap Data.

					St. Johns Bridge Data													
Analyte	Fraction	Analyte Group	Units	Matrix	N	FOD (%)	Minimum	Maximum	Mean	Geomean	Median	Standard Deviation	COV	5th Percentile	95th Percentile	N	FOD (%)	Minimum
PCB077	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	243	--	--	--	--	--	--	2	0	408
PCB081	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	32.8	--	--	--	--	--	--	2	0	11.5
PCB105	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	1730	--	--	--	--	--	--	2	0	1840
PCB106 & 118	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	3930	--	--	--	--	--	--	2	0	4390
PCB126	Total	PCB_Congeners	pg/g	SETRAP	1	100	--	--	35.0	--	--	--	--	--	--	2	0	47.3
PCB156 & 157	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	506	--	--	--	--	--	--	2	0	700
PCB169	Total	PCB_Congeners	pg/g	SETRAP	1	100	--	--	18.9	--	--	--	--	--	--	2	100	5.35
Total PCB Congeners	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	125000	--	--	--	--	--	--	2	0	142000
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/g	SETRAP	1	0	--	--	0.110	--	--	--	--	--	--	2	0	4.90
Benzo(a)pyrene	Total	PAHs	µg/kg	SETRAP	1	0	--	--	540	--	--	--	--	--	--	1	0	--
Naphthalene	Total	PAHs	µg/kg	SETRAP	1	0	--	--	110	--	--	--	--	--	--	1	0	--
Total Carcinogenic PAHs	Total	PAHs	µg/kg	SETRAP	1	0	--	--	788	--	--	--	--	--	--	1	0	--
Total PAHs	Total	PAHs	µg/kg	SETRAP	1	0	--	--	8820	--	--	--	--	--	--	1	0	--
4,4'-DDD	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	2.05	--	--	--	--	--	--	1	100	--
4,4'-DDT	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	7.00	--	--	--	--	--	--	1	100	--
Aldrin	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	1.25	--	--	--	--	--	--	1	100	--
Dieldrin	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	2.05	--	--	--	--	--	--	1	100	--
gamma-Hexachlorocyclohexane	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	2.05	--	--	--	--	--	--	1	100	--
Sum DDD	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	2.05	--	--	--	--	--	--	1	100	--
Sum DDE	Total	Pesticides	µg/kg	SETRAP	1	0	--	--	12.0	--	--	--	--	--	--	1	0	--
Sum DDT	Total	Pesticides	µg/kg	SETRAP	1	0	--	--	5.10	--	--	--	--	--	--	1	100	--
Total Chlordane	Total	Pesticides	µg/kg	SETRAP	1	100	--	--	2.25	--	--	--	--	--	--	1	0	--
Total DDTs	Total	Pesticides	µg/kg	SETRAP	1	0	--	--	17.1	--	--	--	--	--	--	1	0	--
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/kg	SETRAP	1	0	--	--	39000	--	--	--	--	--	--	1	0	--
Hexachlorobenzene	Total	SVOCs	µg/kg	SETRAP	1	100	--	--	0.750	--	--	--	--	--	--	1	100	--
PCB077	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	6600	--	--	--	--	--	--	2	0	5390
PCB081	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	891	--	--	--	--	--	--	2	0	182
PCB105	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	47000	--	--	--	--	--	--	2	0	23300
PCB106 & 118	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	107000	--	--	--	--	--	--	2	0	53400
PCB126	Total	PCB_Congeners	pg/g-OC	SETRAP	1	100	--	--	951	--	--	--	--	--	--	2	0	713
PCB156 & 157	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	13800	--	--	--	--	--	--	2	0	8650
PCB169	Total	PCB_Congeners	pg/g-OC	SETRAP	1	100	--	--	512	--	--	--	--	--	--	2	100	84.8
Total PCB Congeners	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	3400000	--	--	--	--	--	--	2	0	1770000
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/g-OC	SETRAP	1	0	--	--	2.99	--	--	--	--	--	--	2	0	73.0
Benzo(a)pyrene	Total	PAHs	µg/kg-OC	SETRAP	1	0	--	--	14700	--	--	--	--	--	--	1	0	--
Naphthalene	Total	PAHs	µg/kg-OC	SETRAP	1	0	--	--	2990	--	--	--	--	--	--	1	0	--
Total Carcinogenic PAHs	Total	PAHs	µg/kg-OC	SETRAP	1	0	--	--	21400	--	--	--	--	--	--	1	0	--
Total PAHs	Total	PAHs	µg/kg-OC	SETRAP	1	0	--	--	240000	--	--	--	--	--	--	1	0	--
4,4'-DDD	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	55.7	--	--	--	--	--	--	1	100	--
4,4'-DDT	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	190	--	--	--	--	--	--	1	100	--
Aldrin	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	34.0	--	--	--	--	--	--	1	100	--
Dieldrin	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	55.7	--	--	--	--	--	--	1	100	--
gamma-Hexachlorocyclohexane	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	55.7	--	--	--	--	--	--	1	100	--
Sum DDD	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	55.7	--	--	--	--	--	--	1	100	--

Table 4-6. St. Johns Bridge Sediment Trap Data versus Major Transportation Sediment Trap Data.

					St. Johns Bridge Data													
Analyte	**Fraction**	**Analyte Group**	**Units**	**Matrix**	**N**	**FOD (%)**	**Minimum**	**Maximum**	**Mean**	**Geomean**	**Median**	**Standard Deviation**	**COV**	**5th Percentile**	**95th Percentile**	**N**	**FOD (%)**	**Minimum**
Sum DDE	Total	Pesticides	µg/kg-OC	SETRAP	1	0	--	--	326	--	--	--	--	--	--	1	0	--
Sum DDT	Total	Pesticides	µg/kg-OC	SETRAP	1	0	--	--	139	--	--	--	--	--	--	1	100	--
Total Chlordane	Total	Pesticides	µg/kg-OC	SETRAP	1	100	--	--	61.1	--	--	--	--	--	--	1	0	--
Total DDTs	Total	Pesticides	µg/kg-OC	SETRAP	1	0	--	--	465	--	--	--	--	--	--	1	0	--
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/kg-OC	SETRAP	1	0	--	--	1060000	--	--	--	--	--	--	1	0	--
Hexachlorobenzene	Total	SVOCs	µg/kg-OC	SETRAP	1	100	--	--	20.4	--	--	--	--	--	--	1	100	--

Table 4-6. St. Johns Bridge Sediment Trap Data versus Major Transportation Sediment Trap Data.

Analyte	Fraction	Analyte Group	Units	Matrix	LWG Collected Major Transportation Land Use Representative Data							
					Maximum	Mean	Geomean	Median	Standard Deviation	COV	5th Percentile	95th Percentile
PCB077	Total	PCB_Congeners	pg/g	SETRAP	679	544	526	544	192	0.353	422	665
PCB081	Total	PCB_Congeners	pg/g	SETRAP	96.0	53.8	33.2	53.8	59.8	1.11	15.7	91.8
PCB105	Total	PCB_Congeners	pg/g	SETRAP	2930	2390	2320	2390	771	0.323	1890	2880
PCB106 & 118	Total	PCB_Congeners	pg/g	SETRAP	6730	5560	5440	5560	1650	0.298	4510	6610
PCB126	Total	PCB_Congeners	pg/g	SETRAP	89.9	68.6	65.2	68.6	30.1	0.439	49.4	87.8
PCB156 & 157	Total	PCB_Congeners	pg/g	SETRAP	1090	895	873	895	276	0.308	720	1070
PCB169	Total	PCB_Congeners	pg/g	SETRAP	11.8	8.58	7.95	8.58	4.56	0.532	5.67	11.5
Total PCB Congeners	Total	PCB_Congeners	pg/g	SETRAP	223000	183000	178000	183000	57300	0.314	146000	219000
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/g	SETRAP	9.20	7.05	6.71	7.05	3.04	0.431	5.12	8.99
Benzo(a)pyrene	Total	PAHs	µg/kg	SETRAP	--	680	--	--	--	--	--	--
Naphthalene	Total	PAHs	µg/kg	SETRAP	--	220	--	--	--	--	--	--
Total Carcinogenic PAHs	Total	PAHs	µg/kg	SETRAP	--	930	--	--	--	--	--	--
Total PAHs	Total	PAHs	µg/kg	SETRAP	--	11200	--	--	--	--	--	--
4,4'-DDD	Total	Pesticides	µg/kg	SETRAP	--	2.00	--	--	--	--	--	--
4,4'-DDT	Total	Pesticides	µg/kg	SETRAP	--	5.50	--	--	--	--	--	--
Aldrin	Total	Pesticides	µg/kg	SETRAP	--	0.550	--	--	--	--	--	--
Dieldrin	Total	Pesticides	µg/kg	SETRAP	--	2.00	--	--	--	--	--	--
gamma-Hexachlorocyclohexane	Total	Pesticides	µg/kg	SETRAP	--	0.430	--	--	--	--	--	--
Sum DDD	Total	Pesticides	µg/kg	SETRAP	--	2.00	--	--	--	--	--	--
Sum DDE	Total	Pesticides	µg/kg	SETRAP	--	3.40	--	--	--	--	--	--
Sum DDT	Total	Pesticides	µg/kg	SETRAP	--	5.50	--	--	--	--	--	--
Total Chlordane	Total	Pesticides	µg/kg	SETRAP	--	8.80	--	--	--	--	--	--
Total DDTs	Total	Pesticides	µg/kg	SETRAP	--	3.40	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/kg	SETRAP	--	19000	--	--	--	--	--	--
Hexachlorobenzene	Total	SVOCs	µg/kg	SETRAP	--	1.20	--	--	--	--	--	--
PCB077	Total	PCB_Congeners	pg/g-OC	SETRAP	6470	5930	5900	5930	762	0.128	5440	6410
PCB081	Total	PCB_Congeners	pg/g-OC	SETRAP	762	472	373	472	410	0.868	211	733
PCB105	Total	PCB_Congeners	pg/g-OC	SETRAP	29200	26200	26000	26200	4180	0.159	23500	28900
PCB106 & 118	Total	PCB_Congeners	pg/g-OC	SETRAP	69600	61500	61000	61500	11400	0.186	54200	68800
PCB126	Total	PCB_Congeners	pg/g-OC	SETRAP	750	732	731	732	25.5	0.0349	715	748
PCB156 & 157	Total	PCB_Congeners	pg/g-OC	SETRAP	11100	9870	9800	9870	1730	0.175	8770	11000
PCB169	Total	PCB_Congeners	pg/g-OC	SETRAP	93.7	89.2	89.1	89.2	6.27	0.0703	85.2	93.2
Total PCB Congeners	Total	PCB_Congeners	pg/g-OC	SETRAP	2250000	2010000	2000000	2010000	340000	0.169	1790000	2230000
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/g-OC	SETRAP	77.7	75.3	75.3	75.3	3.28	0.0435	73.2	77.4
Benzo(a)pyrene	Total	PAHs	µg/kg-OC	SETRAP	--	10800	--	--	--	--	--	--
Naphthalene	Total	PAHs	µg/kg-OC	SETRAP	--	3490	--	--	--	--	--	--
Total Carcinogenic PAHs	Total	PAHs	µg/kg-OC	SETRAP	--	14700	--	--	--	--	--	--
Total PAHs	Total	PAHs	µg/kg-OC	SETRAP	--	177000	--	--	--	--	--	--
4,4'-DDD	Total	Pesticides	µg/kg-OC	SETRAP	--	31.7	--	--	--	--	--	--
4,4'-DDT	Total	Pesticides	µg/kg-OC	SETRAP	--	87.2	--	--	--	--	--	--
Aldrin	Total	Pesticides	µg/kg-OC	SETRAP	--	8.72	--	--	--	--	--	--
Dieldrin	Total	Pesticides	µg/kg-OC	SETRAP	--	31.7	--	--	--	--	--	--
gamma-Hexachlorocyclohexane	Total	Pesticides	µg/kg-OC	SETRAP	--	6.81	--	--	--	--	--	--
Sum DDD	Total	Pesticides	µg/kg-OC	SETRAP	--	31.7	--	--	--	--	--	--

Table 4-6. St. Johns Bridge Sediment Trap Data versus Major Transportation Sediment Trap Data.

Analyte	Fraction	Analyte Group	Units	Matrix	LWG Collected Major Transportation Land Use Representative Data							
					Maximum	Mean	Geomean	Median	Standard Deviation	COV	5th Percentile	95th Percentile
Sum DDE	Total	Pesticides	µg/kg-OC	SETRAP	--	53.9	--	--	--	--	--	--
Sum DDT	Total	Pesticides	µg/kg-OC	SETRAP	--	87.2	--	--	--	--	--	--
Total Chlordane	Total	Pesticides	µg/kg-OC	SETRAP	--	139	--	--	--	--	--	--
Total DDTs	Total	Pesticides	µg/kg-OC	SETRAP	--	53.9	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/kg-OC	SETRAP	--	301000	--	--	--	--	--	--
Hexachlorobenzene	Total	SVOCs	µg/kg-OC	SETRAP	--	19.0	--	--	--	--	--	--

Table 4-7. St. Johns Bridge Composite Stormwater Data versus Major Transportation Stormwater Data and Literature Values.

Analyte	Fraction	Analyte Group	Units	Matrix	St. Johns Bridge Data										
					N	FOD (%)	Minimum	Maximum	Mean	Geomean	Median	Standard Deviation	COV	5th Percentile	95th Percentile
PCB077	Total	PCB_Congeners	pg/L	WO	3	33	8.10	465	246	99.8	264	229	0.932	33.7	445
PCB081	Total	PCB_Congeners	pg/L	WO	3	100	4.48	8.30	5.84	5.60	4.73	2.14	0.366	4.51	7.94
PCB105	Total	PCB_Congeners	pg/L	WO	3	0	96.6	2370	1160	612	1000	1140	0.991	187	2230
PCB106 & 118	Total	PCB_Congeners	pg/L	WO	3	0	239	5710	2690	1420	2110	2780	1.04	426	5350
PCB126	Total	PCB_Congeners	pg/L	WO	3	67	6.00	61.6	26.8	16.8	12.9	30.3	1.13	6.69	56.7
PCB156 & 157	Total	PCB_Congeners	pg/L	WO	3	33	11.6	892	408	149	321	447	1.09	42.5	835
PCB169	Total	PCB_Congeners	pg/L	WO	3	100	3.01	14.9	8.29	6.78	6.95	6.06	0.731	3.40	14.1
Total PCB Congeners	Total	PCB_Congeners	pg/L	WO	3	0	8500	185000	93100	51300	85700	88500	0.951	16200	175000
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/L	WO	3	0	0.00290	6.30	2.13	0.110	0.0730	3.62	1.70	0.00991	5.68
Arsenic	Total	Metals	µg/L	WO	4	0	0.823	0.982	0.881	0.879	0.860	0.0698	0.0793	0.827	0.965
Chromium	Total	Metals	µg/L	WO	4	0	6.85	28.2	15.2	12.6	12.8	10.3	0.679	6.87	26.8
Copper	Total	Metals	µg/L	WO	4	0	30.9	65.0	42.9	41.0	37.9	15.8	0.369	31.1	61.8
Lead	Total	Metals	µg/L	WO	4	0	23.2	75.2	39.6	35.2	30.0	24.2	0.611	23.6	69.1
Mercury	Total	Metals	µg/L	WO	4	75	0.0100	0.0600	0.0300	0.0237	0.0250	0.0227	0.758	0.0108	0.0563
Nickel	Total	Metals	µg/L	WO	4	0	5.17	12.7	8.30	7.88	7.67	3.16	0.381	5.53	12.0
Zinc	Total	Metals	µg/L	WO	4	0	486	1140	756	721	700	276	0.365	514	1080
Benzo(a)pyrene	Total	PAHs	µg/L	WO	3	0	0.110	0.650	0.300	0.216	0.140	0.303	1.01	0.113	0.599
Naphthalene	Total	PAHs	µg/L	WO	3	33	0.0700	0.380	0.200	0.159	0.150	0.161	0.805	0.0780	0.357
Total Carcinogenic PAHs	Total	PAHs	µg/L	WO	3	0	0.180	0.980	0.473	0.358	0.260	0.441	0.931	0.188	0.908
Total PAHs	Total	PAHs	µg/L	WO	3	0	2.30	12.1	5.97	4.60	3.50	5.35	0.896	2.42	11.2
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/L	WO	3	0	2.60	17.0	9.60	7.41	9.20	7.21	0.751	3.26	16.2

Table 4-7. St. Johns Bridge Composite Stormwater Data versus Major Transportation Stormwater Data and Literature Values.

Analyte	Fraction	Analyte Group	Units	Matrix	LWG Collected Major Transportation Land Use Representative Data										
					N	FOD (%)	Minimum	Maximum	Mean	Geomean	Median	Standard Deviation	COV	5th Percentile	95th Percentile
PCB077	Total	PCB_Congeners	pg/L	WO	7	0	35.6	161	94.1	81.4	103	50.4	0.536	36.9	158
PCB081	Total	PCB_Congeners	pg/L	WO	7	14	3.30	11.2	5.44	4.99	4.09	2.75	0.505	3.44	9.66
PCB105	Total	PCB_Congeners	pg/L	WO	7	0	170	711	408	370	413	186	0.457	192	661
PCB106 & 118	Total	PCB_Congeners	pg/L	WO	7	0	387	1700	955	866	919	438	0.459	448	1560
PCB126	Total	PCB_Congeners	pg/L	WO	7	29	6.25	17.2	11.0	10.2	10.0	4.48	0.408	6.34	16.7
PCB156 & 157	Total	PCB_Congeners	pg/L	WO	7	0	67.5	249	145	133	120	63.2	0.437	76.7	233
PCB169	Total	PCB_Congeners	pg/L	WO	7	100	1.81	5.75	3.60	3.40	3.33	1.29	0.359	2.09	5.43
Total PCB Congeners	Total	PCB_Congeners	pg/L	WO	7	0	13400	52400	31900	28700	35700	14500	0.454	14000	49300
Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	Total	PCB_Congeners	pg/L	WO	7	0	0.0150	1.80	0.925	0.367	1.00	0.727	0.786	0.0174	1.74
Arsenic	Total	Metals	µg/L	WO	9	0	0.520	2.33	1.27	1.14	1.27	0.600	0.472	0.548	2.13
Chromium	Total	Metals	µg/L	WO	9	0	4.99	14.8	8.92	8.38	8.63	3.34	0.375	5.24	13.9
Copper	Total	Metals	µg/L	WO	9	0	24.6	66.0	44.8	41.4	38.1	18.1	0.404	24.9	65.6
Lead	Total	Metals	µg/L	WO	9	0	7.62	38.6	19.1	16.8	18.2	10.1	0.529	8.33	34.3
Mercury	Total	Metals	µg/L	WO	9	100	0.015	0.0150	0.0150	0.0150	0.0150	0.00000000	0.00000001	0.0150	0.0150
Nickel	Total	Metals	µg/L	WO	9	0	2.93	10.1	6.37	5.85	7.42	2.58	0.404	2.99	9.57
Zinc	Total	Metals	µg/L	WO	9	0	113	334	215	199	230	84.0	0.391	114	326
Benzo(a)pyrene	Total	PAHs	µg/L	WO	7	0	0.0520	0.170	0.105	0.0983	0.0920	0.0404	0.384	0.0577	0.158
Naphthalene	Total	PAHs	µg/L	WO	7	43	0.0333	0.190	0.0766	0.0645	0.0631	0.0542	0.708	0.0335	0.161
Total Carcinogenic PAHs	Total	PAHs	µg/L	WO	7	0	0.0810	0.280	0.174	0.163	0.150	0.0663	0.380	0.0957	0.262
Total PAHs	Total	PAHs	µg/L	WO	7	0	0.960	3.40	2.22	2.09	2.40	0.752	0.338	1.24	3.16
Bis(2-ethylhexyl) phthalate	Total	Phthalates	µg/L	WO		--	--	--	--	--	--	--	--	--	--

Table 7-1. Evaluation of Segregated Samples at OF-18

Station	Analyte	Units	Measured Loads		Calculated Loads			
			Segregated Data	Unsegregated Data	5th Percentile	Mean	Geomean	95th Percentile
OF18	Benzo(a)pyrene	µg	8.27E+05	9.20E+05	7.44E+04	2.90E+05	1.81E+05	7.61E+05
OF18	Lead	µg	5.11E+08	5.66E+08	2.38E+07	1.26E+08	6.39E+07	2.07E+08
OF18	PCB077	pg	3.13E+09	3.89E+09	7.56E+07	1.50E+09	5.10E+08	4.24E+09
OF18	PCB105	pg	1.61E+10	3.08E+10	3.72E+08	9.53E+09	3.37E+09	3.15E+10
OF18	PCB106 & 118	pg	4.02E+10	7.72E+10	8.28E+08	2.22E+10	7.67E+09	6.59E+10
OF18	PCB126	pg	3.42E+08	5.40E+08	4.48E+07	2.38E+08	1.33E+08	9.26E+08
OF18	PCB156 & 157	pg	1.26E+10	1.60E+10	1.59E+08	3.75E+09	1.42E+09	1.23E+10
OF18	Total PCB Congeners	pg	1.38E+12	2.38E+12	1.72E+10	6.41E+11	2.22E+11	1.88E+12
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	pg	3.58E+07	3.57E+07	1.57E+05	2.14E+07	5.25E+06	9.11E+07

Note: The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

Table 7-2. Sediment Trap Comparison of Measured Loads vs. Calculated Loads

Location	Analyte	Analyte Group	Units	Basis	Measured Load	Calculated Load				Measured Load Within Upper- and Lower-Bound Calculated Load	RPD*
						5th Percentile	Mean	Geomean	95th Percentile		
OF18	Lead	Metals	µg	Dry	1.1E+08	1.4E+07	3.8E+07	3.5E+07	1.3E+08	TRUE	97
OF18	Mercury	Metals	µg	Dry	1.9E+05	2.4E+04	4.4E+04	3.4E+04	6.4E+04	FALSE	125
OF18	Total PAHs	PAHs	µg	Dry	1.3E+07	6.2E+05	6.5E+06	4.8E+06	8.8E+07	TRUE	64
OF18	Total PCB Congeners	PCB Congeners	pg	Dry	4.7E+11	2.2E+10	1.4E+11	7.4E+10	3.2E+11	FALSE	111
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	Dry	4.6E+06	1.2E+05	4.7E+06	1.7E+06	1.8E+07	TRUE	1
OF18	Total DDTs	Pesticides	µg	Dry	1.3E+05	4.5E+03	2.0E+04	1.6E+04	1.1E+05	FALSE	147
OF18	Bis(2-ethylhexyl) phthalate	Phthalates	µg	Dry	1.7E+07	5.6E+05	2.1E+06	2.0E+06	1.4E+07	FALSE	157
OF18	Hexachlorobenzene	SVOCs	µg	Dry	3.3E+03	1.8E+02	6.1E+02	5.4E+02	1.8E+03	FALSE	137
OF18	Lead	Metals	µg	OC normalized	1.3E+08	8.4E+07	2.7E+08	1.8E+08	5.0E+08	TRUE	70
OF18	Mercury	Metals	µg	OC normalized	2.2E+05	1.1E+05	3.6E+05	2.0E+05	7.6E+05	TRUE	48
OF18	Total PAHs	PAHs	µg	OC normalized	1.8E+07	5.2E+06	3.9E+07	2.5E+07	9.6E+08	TRUE	76
OF18	Total PCB Congeners	PCB Congeners	pg	OC normalized	6.5E+11	6.6E+10	7.6E+11	3.0E+11	2.4E+12	TRUE	15
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	OC normalized	5.3E+06	2.7E+05	2.1E+07	6.4E+06	6.8E+07	TRUE	121
OF18	Total DDTs	Pesticides	µg	OC normalized	1.8E+05	2.8E+04	1.3E+05	8.9E+04	5.7E+05	TRUE	31
OF18	Bis(2-ethylhexyl) phthalate	Phthalates	µg	OC normalized	2.4E+07	2.5E+06	9.3E+06	9.8E+06	5.1E+07	TRUE	88
OF18	Hexachlorobenzene	SVOCs	µg	OC normalized	4.0E+03	6.5E+02	3.0E+03	2.7E+03	1.4E+04	TRUE	27
OF19	Lead	Metals	µg	Dry	1.5E+08	1.2E+07	3.3E+07	3.0E+07	1.1E+08	FALSE	126
OF19	Mercury	Metals	µg	Dry	2.3E+05	2.1E+04	3.8E+04	2.9E+04	5.5E+04	FALSE	142
OF19	Total PAHs	PAHs	µg	Dry	1.6E+07	5.9E+05	5.7E+06	4.2E+06	7.6E+07	TRUE	97
OF19	Total PCB Congeners	PCB Congeners	pg	Dry	2.3E+11	2.0E+10	1.2E+11	6.5E+10	2.7E+11	TRUE	63
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	Dry	9.9E+06	1.2E+05	4.1E+06	1.5E+06	1.6E+07	TRUE	84
OF19	Total DDTs	Pesticides	µg	Dry	6.7E+03	3.9E+03	1.7E+04	1.4E+04	9.2E+04	TRUE	88
OF19	Bis(2-ethylhexyl) phthalate	Phthalates	µg	Dry	2.1E+07	5.9E+05	1.9E+06	1.8E+06	1.3E+07	FALSE	167
OF19	Hexachlorobenzene	SVOCs	µg	Dry	7.4E+02	1.6E+02	5.2E+02	4.6E+02	1.6E+03	TRUE	36
OF19	Lead	Metals	µg	OC normalized	1.8E+08	7.4E+07	2.3E+08	1.5E+08	4.4E+08	TRUE	23
OF19	Mercury	Metals	µg	OC normalized	2.8E+05	9.8E+04	3.1E+05	1.7E+05	6.6E+05	TRUE	9
OF19	Total PAHs	PAHs	µg	OC normalized	2.0E+07	4.6E+06	3.4E+07	2.1E+07	8.3E+08	TRUE	49
OF19	Total PCB Congeners	PCB Congeners	pg	OC normalized	2.8E+11	5.9E+10	6.6E+11	2.6E+11	2.0E+12	TRUE	79
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	OC normalized	1.2E+07	2.8E+05	1.8E+07	5.6E+06	5.9E+07	TRUE	39
OF19	Total DDTs	Pesticides	µg	OC normalized	8.3E+03	2.4E+04	1.1E+05	7.7E+04	5.0E+05	FALSE	172
OF19	Bis(2-ethylhexyl) phthalate	Phthalates	µg	OC normalized	2.6E+07	2.4E+06	8.3E+06	8.7E+06	4.5E+07	TRUE	105
OF19	Hexachlorobenzene	SVOCs	µg	OC normalized	9.3E+02	5.6E+02	2.6E+03	2.3E+03	1.2E+04	TRUE	96
Yeon-NW35	Total PCB Congeners	PCB Congeners	pg	Dry	2.2E+10	9.1E+09	4.8E+10	2.7E+10	1.1E+11	TRUE	75
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	Dry	8.3E+05	1.0E+05	1.7E+06	6.5E+05	6.3E+06	TRUE	67
Yeon-NW35	Total PCB Congeners	PCB Congeners	pg	OC normalized	1.6E+11	2.2E+10	2.6E+11	1.0E+11	8.0E+11	TRUE	44
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	OC normalized	6.3E+06	2.1E+05	7.3E+06	2.3E+06	2.3E+07	TRUE	15

Notes:
*Relative percent difference between measured load and mean calculated load
The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

Table 7-3. Composite Water Comparison of Annual Measured Loads vs. Calculated Loads

Location	Analyte	Analyte Group	Units	Measured Load	Calculated Load				Measured Load Within Upper- and Lower-Bound Calculated Load	RPD*
					5th Percentile	Mean	Geomean	95th Percentile		
OF18	Lead	Metals	µg	5.1E+08	2.4E+07	1.3E+08	6.4E+07	2.1E+08	FALSE	121
OF18	Mercury	Metals	µg	4.9E+05	1.7E+05	2.7E+05	2.3E+05	4.3E+05	FALSE	57
OF18	Total PAHs	PAHs	µg	1.6E+07	9.7E+05	5.8E+06	4.3E+06	1.6E+07	FALSE	94
OF18	Total PCB Congeners	PCB Congeners	pg	1.4E+12	1.7E+10	6.4E+11	2.2E+11	1.9E+12	TRUE	73
OF18	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	3.6E+07	1.6E+05	2.1E+07	5.3E+06	9.1E+07	TRUE	50
OF19	Lead	Metals	µg	2.7E+08	2.1E+07	1.1E+08	5.6E+07	1.8E+08	FALSE	84
OF19	Mercury	Metals	µg	2.9E+05	1.5E+05	2.4E+05	2.0E+05	3.7E+05	TRUE	20
OF19	Total PAHs	PAHs	µg	1.3E+07	9.6E+05	5.2E+06	3.8E+06	1.4E+07	TRUE	84
OF19	Total PCB Congeners	PCB Congeners	pg	4.2E+11	1.6E+10	5.6E+11	1.9E+11	1.6E+12	TRUE	28
OF19	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	2.1E+07	1.8E+05	1.9E+07	4.6E+06	7.9E+07	TRUE	11
Yeon-NW35	Lead	Metals	µg	1.3E+07	7.2E+06	4.3E+07	2.1E+07	7.1E+07	TRUE	104
Yeon-NW35	Mercury	Metals	µg	3.9E+04	1.1E+04	4.4E+04	3.0E+04	9.8E+04	TRUE	12
Yeon-NW35	Total PAHs	PAHs	µg	8.7E+05	5.6E+05	2.3E+06	1.7E+06	5.7E+06	TRUE	89
Yeon-NW35	Total PCB Congeners	PCB Congeners	pg	2.7E+10	8.2E+09	2.2E+11	7.9E+10	6.4E+11	TRUE	156
Yeon-NW35	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	PCB Congeners	pg	3.0E+04	1.6E+05	7.4E+06	1.9E+06	3.1E+07	FALSE	198

Notes:
*Relative percent difference between measured load and mean calculated load
The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Fraction	Analyte Group	Units	Basis	Processed Data Summary Statistics (Samples Averaged by Site)							
						N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile
Heavy Industrial	Arsenic	total	Metals	µg/L	NA	19	18	5	0.05452	8.24	2.02	0.944	6.75
Heavy Industrial	Chromium	total	Metals	µg/L	NA	17	17	0	1.25	9.00	4.49	4.03	8.97
Heavy Industrial	Copper	total	Metals	µg/L	NA	15	15	0	4.88	62.8	27.4	23.2	56.5
Heavy Industrial	Lead	total	Metals	µg/L	NA	17	17	0	2.99	48.3	19.8	14.5	48.2
Heavy Industrial	Mercury	total	Metals	µg/L	NA	17	9	47	0.0043	0.0750	0.0263	0.0213	0.0701
Heavy Industrial	Nickel	total	Metals	µg/L	NA	19	19	0	1.69	12.2	5.48	5.03	10.5
Heavy Industrial	Zinc	total	Metals	µg/L	NA	16	16	0	54.1	427	213	209	375
Heavy Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	19	19	0	2121	658333	148155	92600	467796
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	19	19	0	0.00180	31.4	6.31	2.66	22.8
Heavy Industrial	PCB077	total	PCB_Congeners	pg/L	NA	19	19	0	6.58	1875	324	108	1051
Heavy Industrial	PCB081	total	PCB_Congeners	pg/L	NA	19	10	47	0.75	25.3	4.87	1.67	14.5
Heavy Industrial	PCB105	total	PCB_Congeners	pg/L	NA	19	19	0	40.9	9150	2156	1010	7845
Heavy Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	19	19	0	89.8	22493	5094	2402	16388
Heavy Industrial	PCB126	total	PCB_Congeners	pg/L	NA	19	16	16	2.75	300	61.4	25.1	224
Heavy Industrial	PCB156 & 157	total	PCB_Congeners	pg/L	NA	19	19	0	15.4	4590	948	662	3071
Heavy Industrial	PCB169	total	PCB_Congeners	pg/L	NA	19	2	89	2.80	33.9	6.28	3.25	29.4
Heavy Industrial	Aldrin	total	Pesticides	µg/L	NA	5	3	40	0.000407	0.00185	0.00106	0.000848	0.00178
Heavy Industrial	Dieldrin	total	Pesticides	µg/L	NA	4	2	50	0.000275	0.00241	0.00112	0.000906	0.00220
Heavy Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	5	4	20	0.000849	0.00310	0.00191	0.00193	0.00299
Heavy Industrial	Total Chlordane	total	Pesticides	µg/L	NA	4	4	0	0.00174	0.00796	0.00598	0.00710	0.00785
Heavy Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	4	3	25	0.00100	0.00234	0.00157	0.00146	0.00224
Heavy Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	4	2	50	0.002873	0.00799	0.00538	0.00533	0.00783
Heavy Industrial	Sum DDD	total	Pesticides	µg/L	NA	4	3	25	0.00063	0.00634	0.00260	0.00171	0.00566
Heavy Industrial	Sum DDE	total	Pesticides	µg/L	NA	4	3	25	0.000350	0.00266	0.00129	0.00107	0.00247
Heavy Industrial	Sum DDT	total	Pesticides	µg/L	NA	4	3	25	0.000803	0.00878	0.00474	0.00469	0.00853
Heavy Industrial	Total DDTs	total	Pesticides	µg/L	NA	4	3	25	0.00330	0.0126	0.00867	0.00941	0.0122
Heavy Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	17	16	6	0.00553	0.193	0.0552	0.0367	0.179
Heavy Industrial	Naphthalene	total	PAHs	µg/L	NA	21	11	48	0.0076	0.568	0.0597	0.0247	0.098
Heavy Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	17	16	6	0.00300	0.305	0.0883	0.0593	0.286
Heavy Industrial	Total PAHs	total	PAHs	µg/L	NA	19	18	5	0.0705	5.10	1.45	0.900	3.81
Heavy Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	9	8	11	0.645	2.93	1.52	1.34	2.72
Heavy Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	6	4	33	0.00004	0.0901	0.0154	0.0004	0.0679

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

						Processed Data Summary Statistics (Samples Averaged by Site)							
Land Use	**Analyte**	**Fraction**	**Analyte Group**	**Units**	**Basis**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Light Industrial	Arsenic	total	Metals	µg/L	NA	4	4	0	0.200	1.65	0.763	0.602	1.54
Light Industrial	Chromium	total	Metals	µg/L	NA	4	4	0	1.87	6.08	4.14	4.31	6.07
Light Industrial	Copper	total	Metals	µg/L	NA	4	4	0	5.20	16.5	10.8	10.8	15.7
Light Industrial	Lead	total	Metals	µg/L	NA	4	4	0	4.66	26.4	15.6	15.6	26.0
Light Industrial	Mercury	total	Metals	µg/L	NA	4	2	50	0.0124	0.0268	0.0209	0.0222	0.0266
Light Industrial	Nickel	total	Metals	µg/L	NA	4	4	0	1.72	2.73	2.10	1.97	2.62
Light Industrial	Zinc	total	Metals	µg/L	NA	4	4	0	42.1	181	101	89.7	171
Light Industrial	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	4	4	0	8923	49425	20195	11217	43812
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	4	4	0	0.278	1.12	0.559	0.419	1.02
Light Industrial	PCB077	total	PCB_Congeners	pg/L	NA	4	4	0	13.8	121	54.2	40.9	110
Light Industrial	PCB081	total	PCB_Congeners	pg/L	NA	4	2	50	2.01	4.53	2.81	2.35	4.21
Light Industrial	PCB105	total	PCB_Congeners	pg/L	NA	4	4	0	85.6	600	242	142	536
Light Industrial	PCB106 & 118	total	PCB_Congeners	pg/L	NA	4	4	0	201	1385	563	334	1237
Light Industrial	PCB126	total	PCB_Congeners	pg/L	NA	4	4	0	4.42	25.7	12.1	9.22	23.7
Light Industrial	PCB169	total	PCB_Congeners	pg/L	NA	4	2	50	1.75	3.50	2.71	2.79	3.41
Light Industrial	Aldrin	total	Pesticides	µg/L	NA	1	0	100	0.00132	0.00132	0.00132	0.00132	0.00132
Light Industrial	Dieldrin	total	Pesticides	µg/L	NA	1	0	100	0.00146	0.00146	0.00146	0.00146	0.00146
Light Industrial	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	1	1	0	0.00216	0.00216	0.00216	0.00216	0.00216
Light Industrial	Total Chlordane	total	Pesticides	µg/L	NA	1	1	0	0.00233	0.00233	0.00233	0.00233	0.00233
Light Industrial	4,4'-DDD	total	Pesticides	µg/L	NA	1	0	100	0.00185	0.00185	0.00185	0.00185	0.00185
Light Industrial	4,4'-DDT	total	Pesticides	µg/L	NA	1	1	0	0.00926	0.00926	0.00926	0.00926	0.00926
Light Industrial	Sum DDD	total	Pesticides	µg/L	NA	1	1	0	0.00315	0.00315	0.00315	0.00315	0.00315
Light Industrial	Sum DDE	total	Pesticides	µg/L	NA	1	0	100	0.00190	0.00190	0.00190	0.00190	0.00190
Light Industrial	Sum DDT	total	Pesticides	µg/L	NA	1	1	0	0.00941	0.00941	0.00941	0.00941	0.00941
Light Industrial	Total DDTs	total	Pesticides	µg/L	NA	1	1	0	0.0112	0.0112	0.0112	0.0112	0.0112
Light Industrial	Benzo(a)pyrene	total	PAHs	µg/L	NA	4	4	0	0.0235	0.0433	0.0350	0.0367	0.0424
Light Industrial	Naphthalene	total	PAHs	µg/L	NA	4	3	25	0.0140	0.0599	0.0330	0.0290	0.0553
Light Industrial	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	4	4	0	0.0338	0.0770	0.0594	0.0635	0.0755
Light Industrial	Total PAHs	total	PAHs	µg/L	NA	4	4	0	0.463	1.40	0.788	0.644	1.29
Light Industrial	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	3	3	0	1.43	2.24	1.80	1.73	2.19
Light Industrial	Hexachlorobenzene	total	SVOCs	µg/L	NA	1	0	100	0.176	0.176	0.176	0.176	0.176

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Fraction	Analyte Group	Units	Basis	Processed Data Summary Statistics (Samples Averaged by Site)							
						N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile
Open Space	Arsenic	total	Metals	µg/L	NA	1	1	0	0.209	0.209	0.209	0.209	0.209
Open Space	Chromium	total	Metals	µg/L	NA	1	1	0	1.71	1.71	1.71	1.71	1.71
Open Space	Copper	total	Metals	µg/L	NA	1	1	0	1.75	1.75	1.75	1.75	1.75
Open Space	Lead	total	Metals	µg/L	NA	1	1	0	0.803	0.803	0.803	0.803	0.803
Open Space	Mercury	total	Metals	µg/L	NA	1	0	100	0.0150	0.0150	0.0150	0.0150	0.0150
Open Space	Nickel	total	Metals	µg/L	NA	1	1	0	1.44	1.44	1.44	1.44	1.44
Open Space	Zinc	total	Metals	µg/L	NA	1	1	0	8.46	8.46	8.46	8.46	8.46
Open Space	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	1	1	0	288	288	288	288	288
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	1	1	0	0.000563	0.000563	0.000563	0.000563	0.000563
Open Space	PCB077	total	PCB_Congeners	pg/L	NA	1	1	0	2.65	2.65	2.65	2.65	2.65
Open Space	PCB081	total	PCB_Congeners	pg/L	NA	1	0	100	0.988	0.988	0.988	0.988	0.988
Open Space	PCB105	total	PCB_Congeners	pg/L	NA	1	1	0	11.2	11.2	11.2	11.2	11.2
Open Space	PCB106 & 118	total	PCB_Congeners	pg/L	NA	1	1	0	28.8	28.8	28.8	28.8	28.8
Open Space	PCB126	total	PCB_Congeners	pg/L	NA	1	0	100	2.93	2.93	2.93	2.93	2.93
Open Space	PCB169	total	PCB_Congeners	pg/L	NA	1	0	100	1.67	1.67	1.67	1.67	1.67
Open Space	Benzo(a)pyrene	total	PAHs	µg/L	NA	1	0	100	0.00225	0.00225	0.00225	0.00225	0.00225
Open Space	Naphthalene	total	PAHs	µg/L	NA	1	0	100	0.0100	0.0100	0.0100	0.0100	0.0100
Open Space	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	1	1	0	0.00166	0.00166	0.00166	0.00166	0.00166
Open Space	Total PAHs	total	PAHs	µg/L	NA	1	1	0	0.0120	0.0120	0.0120	0.0120	0.0120
Open Space	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	1	1	0	0.307	0.307	0.307	0.307	0.307

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

						Processed Data Summary Statistics (Samples Averaged by Site)							
Land Use	Analyte	Fraction	Analyte Group	Units	Basis	N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile
Residential	Arsenic	total	Metals	µg/L	NA	2	2	0	0.344	0.814	0.579	0.579	0.791
Residential	Chromium	total	Metals	µg/L	NA	2	2	0	1.29	9.6	5.43	5.43	9.2
Residential	Copper	total	Metals	µg/L	NA	2	2	0	8.18	25.9	17.0	17.0	25.0
Residential	Lead	total	Metals	µg/L	NA	2	2	0	2.63	43.4	23.0	23.0	41.4
Residential	Mercury	total	Metals	µg/L	NA	2	1	50	0.0191	0.0432	0.0311	0.0311	0.0420
Residential	Nickel	total	Metals	µg/L	NA	2	2	0	1.59	4.91	3.25	3.25	4.74
Residential	Zinc	total	Metals	µg/L	NA	2	2	0	40.8	179	110	109.8	172
Residential	Total PCB Congeners	total	PCB_Congeners	pg/L	NA	2	2	0	1427	50950	26188	26188	48474
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	total	PCB_Congeners	pg/L	NA	2	2	0	0.00115	1.11	0.555	0.5549	1.05
Residential	PCB077	total	PCB_Congeners	pg/L	NA	2	2	0	5.62	131	68	68	124
Residential	PCB081	total	PCB_Congeners	pg/L	NA	2	0	100	1.97	46.8	24.4	24.37	44.5
Residential	PCB105	total	PCB_Congeners	pg/L	NA	2	2	0	31.7	604	318	318	575
Residential	PCB106 & 118	total	PCB_Congeners	pg/L	NA	2	2	0	70.7	1504	787	787	1432
Residential	PCB126	total	PCB_Congeners	pg/L	NA	2	1	50	3.05	55.0	29.0	29.0	52.4
Residential	PCB169	total	PCB_Congeners	pg/L	NA	2	0	100	2.43	46.4	24.4	24.39	44.2
Residential	Aldrin	total	Pesticides	µg/L	NA	1	0	100	0.00125	0.00125	0.00125	0.00125	0.00125
Residential	Dieldrin	total	Pesticides	µg/L	NA	1	0	100	0.00115	0.00115	0.00115	0.00115	0.00115
Residential	gamma-Hexachlorocyclohexane	total	Pesticides	µg/L	NA	1	1	0	0.00151	0.00151	0.00151	0.00151	0.00151
Residential	Total Chlordane	total	Pesticides	µg/L	NA	1	1	0	0.00198	0.00198	0.00198	0.00198	0.00198
Residential	4,4'-DDD	total	Pesticides	µg/L	NA	1	0	100	0.00161	0.00161	0.00161	0.00161	0.00161
Residential	4,4'-DDT	total	Pesticides	µg/L	NA	1	0	100	0.00210	0.00210	0.00210	0.00210	0.00210
Residential	Sum DDD	total	Pesticides	µg/L	NA	1	0	100	0.00183	0.00183	0.00183	0.00183	0.00183
Residential	Sum DDE	total	Pesticides	µg/L	NA	1	1	0	0.00260	0.00260	0.00260	0.00260	0.00260
Residential	Sum DDT	total	Pesticides	µg/L	NA	1	0	100	0.00210	0.00210	0.00210	0.00210	0.00210
Residential	Total DDTs	total	Pesticides	µg/L	NA	1	1	0	0.00280	0.00280	0.00280	0.00280	0.00280
Residential	Benzo(a)pyrene	total	PAHs	µg/L	NA	2	2	0	0.00495	0.0478	0.0264	0.0264	0.0457
Residential	Naphthalene	total	PAHs	µg/L	NA	2	1	50	0.0066	0.0408	0.0237	0.0237	0.0391
Residential	Total Carcinogenic PAHs	total	PAHs	µg/L	NA	2	2	0	0.00660	0.0728	0.0397	0.0397	0.0695
Residential	Total PAHs	total	PAHs	µg/L	NA	2	2	0	0.0915	0.835	0.463	0.463	0.798
Residential	Bis(2-ethylhexyl) phthalate	total	Phthalates	µg/L	NA	2	2	0	1.90	4.90	3.40	3.40	4.75
Residential	Hexachlorobenzene	total	SVOCs	µg/L	NA	1	0	100	0.04973	0.0497	0.0497	0.0497	0.0497
Residential	Total organic carbon	Total	TOC	mg/L	NA	2	2	0	9.03	9.46	9.25		
Residential	Total organic carbon	Total	Conventionals	mg/L	NA	1	1	0	3.37	3.37	3.37	3.37	3.37
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	2	2	0	17.3	152.7	85.0		
Residential	Total suspended solids	Total	Conventionals	mg/L	NA	1	1	0	61.3	61	61.3	61.333333	61.33333333

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

		Unprocessed Data Summary Statistics												
		Detects Only								All Data				
Land Use	**Analyte**	**N**	**Detects**	**FOD**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**	**Minimum**	**Maximum**	**Mean**	**Median**	**95th Percentile**
Heavy Industrial	Arsenic	100	91	91	0.0910	19.8	2.93	0.870	17.2	0.0910	20.0	3.12	1.03	16.9
Heavy Industrial	Chromium	97	94	97	0.620	495	20.0	3.56	111	0.620	495	19.4	3.44	110
Heavy Industrial	Copper	97	97	100	3.10	809	66.9	23.3	296	3.10	809	66.9	23.3	296
Heavy Industrial	Lead	97	92	95	0.616	2480	78.8	14.6	236	0.616	2480	74.9	13.7	213
Heavy Industrial	Mercury	100	35	35	0.0200	1.79	0.297	0.100	0.985	0.0200	1.79	0.120	0.0225	0.614
Heavy Industrial	Nickel	97	93	96	0.750	170	9.09	4.64	17.7	0.750	170	8.78	4.54	17.1
Heavy Industrial	Zinc	97	97	100	43.6	11900	547	233	2360	43.6	11900	547	233	2360
Heavy Industrial	Total PCB Congeners	85	85	100	344	11600000	362000	52100	1160000	344	11600000	362000	52100	1160000
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	85	84	99	0.00164	264	10.3	1.85	55.8	0.00164	264	10.2	1.80	53.8
Heavy Industrial	PCB077	85	76	89	4.57	18700	753	117	2520	4.57	18700	674	98.0	1430
Heavy Industrial	PCB081	85	23	27	1.96	1340	76.7	6.90	128	0.673	1340	24.4	4.16	36.0
Heavy Industrial	PCB105	85	81	95	14.2	167000	5410	711	18000	8.20	167000	5150	648	17100
Heavy Industrial	PCB106 & 118	77	74	96	25.8	397000	13700	1330	48900	25.8	397000	13200	1140	46500
Heavy Industrial	PCB126	85	63	74	2.97	2420	128	32.8	594	2.96	2420	95.9	17.3	494
Heavy Industrial	PCB156 & 157	8	8	100	11.9	1300	716	687	1290	11.9	1300	716	687	1290
Heavy Industrial	PCB169	85	6	7	8.94	59.8	32.4	29.5	55.5	1.19	75.5	6.62	3.40	23.9
Heavy Industrial	Aldrin	25	6	24	0.000220	0.0270	0.0118	0.0109	0.0255	0.000220	0.0270	0.00389	0.00135	0.0208
Heavy Industrial	Dieldrin	25	7	28	0.000790	0.250	0.110	0.0890	0.244	0.000400	0.250	0.0328	0.00130	0.222
Heavy Industrial	gamma-Hexachlorocyclohexane	25	7	28	0.00100	0.00450	0.00277	0.00310	0.00417	0.000500	0.0180	0.00282	0.00260	0.00740
Heavy Industrial	Total Chlordane	25	14	56	0.000980	0.130	0.0302	0.0122	0.101	0.000980	0.540	0.0336	0.00840	0.121
Heavy Industrial	4,4'-DDD	25	13	52	0.000500	1.10	0.152	0.0790	0.536	0.000490	1.10	0.0799	0.00310	0.160
Heavy Industrial	4,4'-DDT	25	8	32	0.00610	4.80	0.851	0.163	3.51	0.00130	4.80	0.289	0.0110	0.990
Heavy Industrial	Sum DDD	25	19	76	0.000500	1.60	0.145	0.0260	0.412	0.000500	1.60	0.111	0.00700	0.256
Heavy Industrial	Sum DDE	25	16	64	0.000530	2.20	0.297	0.0255	1.29	0.000490	2.20	0.190	0.00380	0.902
Heavy Industrial	Sum DDT	25	19	76	0.000680	7.10	0.588	0.0120	2.78	0.000680	7.10	0.450	0.0110	2.03
Heavy Industrial	Total DDTs	25	22	88	0.00480	11.0	0.858	0.0185	3.51	0.00200	11.0	0.755	0.0150	3.22
Heavy Industrial	Benzo(a)pyrene	85	67	79	0.00540	3.70	0.257	0.0440	1.26	0.00430	3.70	0.211	0.0400	0.918
Heavy Industrial	Naphthalene	86	30	35	0.0170	4.10	0.336	0.0535	1.91	0.00300	4.10	0.139	0.0315	0.273
Heavy Industrial	Total Carcinogenic PAHs	86	76	88	0.0110	22.0	1.61	0.290	7.20	0.00430	22.0	1.43	0.240	5.45
Heavy Industrial	Total PAHs	86	79	92	0.0480	37.0	3.26	0.970	13.0	0.0480	37.0	3.01	0.715	12.0
Heavy Industrial	Bis(2-ethylhexyl) phthalate	48	32	67	0.370	10.0	2.77	1.75	8.14	0.190	10.0	2.07	0.985	7.97
Heavy Industrial	Hexachlorobenzene	25	4	16	0.000360	0.00180	0.00112	0.00117	0.00174	0.000150	0.0150	0.00143	0.000930	0.00435

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Unprocessed Data Summary Statistics												
		Detects Only								All Data				
		N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile	Minimum	Maximum	Mean	Median	95th Percentile
Light Industrial	Arsenic	20	20	100	0.130	2.27	0.789	0.754	1.87	0.130	2.27	0.789	0.754	1.87
Light Industrial	Chromium	20	20	100	1.39	12.7	4.18	2.88	10.3	1.39	12.7	4.18	2.88	10.3
Light Industrial	Copper	20	20	100	2.92	22.9	11.5	9.09	22.2	2.92	22.9	11.5	9.09	22.2
Light Industrial	Lead	20	20	100	2.85	50.4	15.6	8.71	40.8	2.85	50.4	15.6	8.71	40.8
Light Industrial	Mercury	21	5	24	0.0300	0.0500	0.0360	0.0300	0.0480	0.0200	0.200	0.0286	0.0150	0.100
Light Industrial	Nickel	20	20	100	0.820	3.58	2.19	2.10	3.45	0.820	3.58	2.19	2.10	3.45
Light Industrial	Zinc	20	20	100	28.9	227	108	91.9	217	28.9	227	108	91.9	217
Light Industrial	Total PCB Congeners	19	19	100	1700	594000	67800	12200	393000	1700	594000	67800	12200	393000
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	19	19	100	0.00336	14.5	1.62	0.0562	8.33	0.00336	14.5	1.62	0.0562	8.33
Light Industrial	PCB077	19	15	79	20.6	1240	141	51.2	501	9.11	1240	113	30.8	290
Light Industrial	PCB081	19	3	16	2.04	7.49	4.52	4.03	7.14	2.04	15.5	3.19	2.78	7.52
Light Industrial	PCB105	19	19	100	27.6	10200	1090	148	6930	27.6	10200	1090	148	6930
Light Industrial	PCB106 & 118	19	19	100	69.5	32000	2990	353	17300	69.5	32000	2990	353	17300
Light Industrial	PCB126	19	9	47	5.34	136	30.8	12.0	107	4.46	136	17.0	6.91	69.8
Light Industrial	PCB169	19	2	11	3.29	4.04	3.67	3.67	4.00	1.91	17.4	3.12	3.26	5.46
Light Industrial	Aldrin	6	0	0						0.000490	0.00880	0.00124	0.000318	0.00378
Light Industrial	Dieldrin	6	0	0						0.000490	0.00880	0.00129	0.000925	0.00355
Light Industrial	gamma-Hexachlorocyclohexane	6	1	17	0.00280	0.00280	0.00280	0.00280		0.000490	0.00880	0.00177	0.00123	0.00400
Light Industrial	Total Chlordane	6	4	67	0.00120	0.00520	0.00235	0.00150	0.00466	0.00120	0.00730	0.00232	0.00150	0.00481
Light Industrial	4,4'-DDD	6	0	0						0.000490	0.0120	0.00137	0.000575	0.00465
Light Industrial	4,4'-DDT	6	1	17	0.0310	0.0310	0.0310	0.0310		0.000850	0.0310	0.00672	0.00203	0.0244
Light Industrial	Sum DDD	6	1	17	0.00530	0.00530	0.00530	0.00530		0.000970	0.0120	0.00228	0.000675	0.00583
Light Industrial	Sum DDE	6	0	0						0.000490	0.0110	0.00153	0.000800	0.00445
Light Industrial	Sum DDT	6	2	33	0.00180	0.0310	0.0164	0.0164	0.0295	0.000850	0.0310	0.00655	0.00150	0.0244
Light Industrial	Total DDTs	6	2	33	0.00710	0.0310	0.0191	0.0191	0.0298	0.00110	0.0310	0.00774	0.00360	0.0250
Light Industrial	Benzo(a)pyrene	17	16	94	0.0130	0.0920	0.0343	0.0235	0.0635	0.00490	0.0920	0.0324	0.0230	0.0616
Light Industrial	Naphthalene	17	10	59	0.0150	0.110	0.0396	0.0325	0.0834	0.00350	0.110	0.0300	0.0220	0.0628
Light Industrial	Total Carcinogenic PAHs	17	17	100	0.0750	0.750	0.285	0.160	0.638	0.0750	0.750	0.285	0.160	0.638
Light Industrial	Total PAHs	17	17	100	0.250	1.60	0.696	0.460	1.60	0.250	1.60	0.696	0.460	1.60
Light Industrial	Bis(2-ethylhexyl) phthalate	14	14	100	1.00	4.20	1.93	1.60	4.14	1.00	4.20	1.93	1.60	4.14
Light Industrial	Hexachlorobenzene	6	0	0						0.000490	0.00880	0.00124	0.000725	0.00358

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Unprocessed Data Summary Statistics												
		Detects Only								All Data				
		N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile	Minimum	Maximum	Mean	Median	95th Percentile
Open Space	Arsenic	3	3	100	0.196	0.228	0.209	0.202	0.225	0.196	0.228	0.209	0.202	0.225
Open Space	Chromium	3	3	100	0.870	3.05	1.71	1.22	2.87	0.870	3.05	1.71	1.22	2.87
Open Space	Copper	3	3	100	1.01	3.07	1.75	1.16	2.88	1.01	3.07	1.75	1.16	2.88
Open Space	Lead	3	3	100	0.403	1.57	0.803	0.437	1.46	0.403	1.57	0.803	0.437	1.46
Open Space	Mercury	4	0	0						0.0300	0.0300	0.0150	0.0150	0.0150
Open Space	Nickel	3	3	100	0.950	2.10	1.44	1.28	2.02	0.950	2.10	1.44	1.28	2.02
Open Space	Zinc	3	3	100	3.69	13.1	8.46	8.59	12.6	3.69	13.1	8.46	8.59	12.6
Open Space	Total PCB Congeners	5	3	60	80.8	641	310	208	598	52.4	641	197	80.8	554
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	5	3	60	0.000462	0.00238	0.00155	0.00181	0.00232	0.000462	1.61	0.228	0.00238	0.710
Open Space	PCB077	5	1	20	3.92	3.92	3.92	3.92		3.73	6.96	2.66	2.05	3.83
Open Space	PCB081	5	0	0						1.47	4.23	1.40	1.27	2.08
Open Space	PCB105	5	3	60	12.6	18.9	15.6	15.4	18.6	7.64	18.9	11.4	12.6	18.2
Open Space	PCB106 & 118	5	2	40	34.2	47.3	40.8	40.8	46.6	9.80	47.3	22.1	15.4	44.7
Open Space	PCB126	5	0	0						4.31	16.1	4.29	3.32	7.37
Open Space	PCB169	5	0	0						1.69	6.51	2.27	2.26	3.22
Open Space	Benzo(a)pyrene	3	0	0						0.00440	0.00460	0.00225	0.00225	0.00230
Open Space	Naphthalene	5	0	0						0.0150	0.0280	0.00930	0.00850	0.0129
Open Space	Total Carcinogenic PAHs	5	1	20	0.00880	0.00880	0.00880	0.00880		0.00540	0.00880	0.00398	0.00280	0.00760
Open Space	Total PAHs	5	1	20	0.0200	0.0200	0.0200	0.0200		0.0150	0.0200	0.0105	0.00850	0.0177
Open Space	Bis(2-ethylhexyl) phthalate	5	1	20	0.830	0.830	0.830	0.830		0.0710	0.830	0.206	0.0550	0.677

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

		Unprocessed Data Summary Statistics												
		Detects Only								All Data				
Land Use	Analyte	N	Detects	FOD	Minimum	Maximum	Mean	Median	95th Percentile	Minimum	Maximum	Mean	Median	95th Percentile
Residential	Arsenic	6	6	100	0.255	1.36	0.556	0.415	1.17	0.255	1.36	0.556	0.415	1.17
Residential	Chromium	6	6	100	0.830	31.8	6.78	1.59	24.8	0.830	31.8	6.78	1.59	24.8
Residential	Copper	6	6	100	6.92	83.5	21.5	9.28	65.8	6.92	83.5	21.5	9.28	65.8
Residential	Lead	6	6	100	1.39	138	28.2	3.53	109	1.39	138	28.2	3.53	109
Residential	Mercury	6	2	33	0.0300	0.130	0.0800	0.0800	0.125	0.0300	0.130	0.0367	0.0150	0.105
Residential	Nickel	6	6	100	0.980	14.6	3.96	2.01	11.7	0.980	14.6	3.96	2.01	11.7
Residential	Zinc	6	6	100	30.7	609	142	49.6	477	30.7	609	142	49.6	477
Residential	Total PCB Congeners	6	6	100	1140	134000	37600	11800	117000	1140	134000	37600	11800	117000
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	6	6	100	0.000471	3.83	1.12	0.618	3.28	0.000471	3.83	1.12	0.618	3.28
Residential	PCB077	6	4	67	6.82	346	139	102	316	6.30	346	94.0	32.5	296
Residential	PCB081	6	0	0						1.42	13.1	3.27	3.58	5.98
Residential	PCB105	6	4	67	42.5	1580	657	502	1460	31.4	1580	444	149	1370
Residential	PCB106 & 118	6	5	83	53.7	3750	1260	623	3350	53.7	3750	1060	361	3250
Residential	PCB126	6	3	50	11.9	36.1	21.1	15.3	34.0	3.23	36.1	12.1	8.58	30.9
Residential	PCB169	6	0	0						3.17	12.5	3.08	2.72	5.53
Residential	Aldrin	3	0	0						0.000770	0.00530	0.00125	0.000700	0.00246
Residential	Dieldrin	3	0	0						0.000500	0.00530	0.00115	0.000550	0.00244
Residential	gamma-Hexachlorocyclohexane	3	1	33	0.00160	0.00160	0.00160	0.00160		0.000530	0.00530	0.00151	0.00160	0.00255
Residential	Total Chlordane	3	3	100	0.000540	0.00390	0.00198	0.00150	0.00366	0.000540	0.00390	0.00198	0.00150	0.00366
Residential	4,4'-DDD	3	0	0						0.000500	0.00850	0.00161	0.000320	0.00386
Residential	4,4'-DDT	3	0	0						0.00170	0.00670	0.00210	0.00210	0.00323
Residential	Sum DDD	3	0	0						0.000990	0.00850	0.00183	0.000750	0.00390
Residential	Sum DDE	3	1	33	0.000810	0.000810	0.000810	0.000810		0.000810	0.0110	0.00260	0.00150	0.00510
Residential	Sum DDT	3	0	0						0.00170	0.00670	0.00210	0.00210	0.00323
Residential	Total DDTs	3	1	33	0.000810	0.000810	0.000810	0.000810		0.000810	0.0110	0.00280	0.00210	0.00516
Residential	Benzo(a)pyrene	7	5	71	0.00620	0.0990	0.0383	0.0370	0.0874	0.00440	0.0990	0.0280	0.00850	0.0816
Residential	Naphthalene	7	3	43	0.0280	0.0430	0.0330	0.0280	0.0415	0.0180	0.0430	0.0200	0.0115	0.0385
Residential	Total Carcinogenic PAHs	7	7	100	0.0210	0.590	0.180	0.0390	0.497	0.0210	0.590	0.180	0.0390	0.497
Residential	Total PAHs	7	7	100	0.0740	1.40	0.445	0.100	1.19	0.0740	1.40	0.445	0.100	1.19
Residential	Bis(2-ethylhexyl) phthalate	6	6	100	1.00	6.70	3.78	3.60	6.45	1.00	6.70	3.78	3.60	6.45
Residential	Hexachlorobenzene	3	0	0						0.000500	0.00530	0.00113	0.000475	0.00243
Residential	Total organic carbon	8	8	100	4.00	15.6	8.84	8.10	14.9	4.00	15.6	8.84	8.10	14.9
Residential	Total organic carbon	8	8	100	4.00	15.6	8.84	8.10	14.9	4.00	15.6	8.84	8.10	14.9
Residential	Total suspended solids	8	8	100	7.00	230	67.9	27.0	199	7.00	230	67.9	27.0	199
Residential	Total suspended solids	8	8	100	7.00	230	67.9	27.0	199	7.00	230	67.9	27.0	199

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Percent Difference				
		Minimum	Mean	Median	95th Percentile	Maximum
Heavy Industrial	Arsenic	50	43	9	86	83
Heavy Industrial	Chromium	-67	125	-16	170	193
Heavy Industrial	Copper	-45	84	0	136	171
Heavy Industrial	Lead	-132	116	-6	126	192
Heavy Industrial	Mercury	129	128	6	159	184
Heavy Industrial	Nickel	-77	46	-10	48	173
Heavy Industrial	Zinc	-21	88	11	145	186
Heavy Industrial	Total PCB Congeners	-144	84	-56	85	179
Heavy Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	-9	47	-38	81	158
Heavy Industrial	PCB077	-36	70	-10	31	164
Heavy Industrial	PCB081	-10	133	86	85	193
Heavy Industrial	PCB105	-133	82	-44	74	179
Heavy Industrial	PCB106 & 118	-111	89	-71	96	179
Heavy Industrial	PCB126	7	44	-37	75	156
Heavy Industrial	PCB156 & 157	-25	-28	4	-82	-112
Heavy Industrial	PCB169	-81	5	5	-21	76
Heavy Industrial	Aldrin	-60	114	46	168	174
Heavy Industrial	Dieldrin	37	187	36	196	196
Heavy Industrial	gamma-Hexachlorocyclohexane	-52	38	30	85	141
Heavy Industrial	Total Chlordane	-56	140	17	176	194
Heavy Industrial	4,4'-DDD	-68	192	72	194	199
Heavy Industrial	4,4'-DDT	-75	193	69	197	199
Heavy Industrial	Sum DDD	-22	191	121	191	198
Heavy Industrial	Sum DDE	33	197	112	199	200
Heavy Industrial	Sum DDT	-17	196	80	198	200
Heavy Industrial	Total DDTs	-49	195	46	198	200
Heavy Industrial	Benzo(a)pyrene	-25	117	9	135	180
Heavy Industrial	Naphthalene	-86	80	24	94	151
Heavy Industrial	Total Carcinogenic PAHs	36	177	121	180	195
Heavy Industrial	Total PAHs	-38	70	-23	104	152
Heavy Industrial	Bis(2-ethylhexyl) phthalate	-109	31	-30	98	109
Heavy Industrial	Hexachlorobenzene	114	-166	72	-176	-143

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Percent Difference				
		Minimum	Mean	Median	95th Percentile	Maximum
Light Industrial	Arsenic	-42	3	22	19	32
Light Industrial	Chromium	-29	1	-40	52	71
Light Industrial	Copper	-56	6	-17	34	32
Light Industrial	Lead	-48	0	-57	44	63
Light Industrial	Mercury	47	31	-39	116	153
Light Industrial	Nickel	-71	4	6	27	27
Light Industrial	Zinc	-37	7	2	24	23
Light Industrial	Total PCB Congeners	-136	108	8	160	169
Light Industrial	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	-195	97	-153	156	171
Light Industrial	PCB077	-41	70	-28	90	164
Light Industrial	PCB081	2	13	17	56	109
Light Industrial	PCB105	-102	127	4	171	178
Light Industrial	PCB106 & 118	-97	137	6	173	183
Light Industrial	PCB126	1	33	-29	99	136
Light Industrial	PCB169	9	14	16	46	133
Light Industrial	Aldrin	-91	-6	-122	97	148
Light Industrial	Dieldrin	-99	-12	-45	83	143
Light Industrial	gamma-Hexachlorocyclohexane	-126	-20	-55	60	121
Light Industrial	Total Chlordane	-64	0	-43	70	103
Light Industrial	4,4'-DDD	-116	-30	-105	86	147
Light Industrial	4,4'-DDT	-166	-32	-128	90	108
Light Industrial	Sum DDD	-106	-32	-129	60	117
Light Industrial	Sum DDE	-118	-22	-81	80	141
Light Industrial	Sum DDT	-167	-36	-145	89	107
Light Industrial	Total DDTs	-164	-36	-102	77	94
Light Industrial	Benzo(a)pyrene	-131	-8	-46	37	72
Light Industrial	Naphthalene	-120	-9	-28	13	59
Light Industrial	Total Carcinogenic PAHs	76	131	86	158	163
Light Industrial	Total PAHs	-60	-12	-33	21	13
Light Industrial	Bis(2-ethylhexyl) phthalate	-35	7	-8	62	61
Light Industrial	Hexachlorobenzene	-199	-197	-198	-192	-181

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Percent Difference				
		Minimum	Mean	Median	95th Percentile	Maximum
Open Space	Arsenic	-6	0	-3	8	9
Open Space	Chromium	-65	0	-34	50	56
Open Space	Copper	-53	0	-40	49	55
Open Space	Lead	-66	0	-59	58	65
Open Space	Mercury	67	0	0	0	67
Open Space	Nickel	-41	0	-12	33	37
Open Space	Zinc	-79	0	2	39	43
Open Space	Total PCB Congeners	-138	-37	-112	63	76
Open Space	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	-20	199	123	200	200
Open Space	PCB077	34	1	-25	37	90
Open Space	PCB081	39	34	25	71	124
Open Space	PCB105	-38	2	12	48	51
Open Space	PCB106 & 118	-98	-26	-61	43	49
Open Space	PCB126	38	38	13	86	139
Open Space	PCB169	1	30	30	63	118
Open Space	Benzo(a)pyrene	65	0	0	2	69
Open Space	Naphthalene	40	-7	-16	25	95
Open Space	Total Carcinogenic PAHs	106	82	51	128	137
Open Space	Total PAHs	22	-13	-34	38	50
Open Space	Bis(2-ethylhexyl) phthalate	-125	-39	-139	75	92

Table 7-4. Summary Statistics for Processed Data versus Unprocessed Data

Land Use	Analyte	Percent Difference				
		Minimum	Mean	Median	95th Percentile	Maximum
Residential	Arsenic	-30	-4	-33	39	50
Residential	Chromium	-44	22	-109	92	107
Residential	Copper	-17	23	-59	90	105
Residential	Lead	-62	20	-147	90	104
Residential	Mercury	44	16	-70	86	100
Residential	Nickel	-47	20	-47	85	99
Residential	Zinc	-28	26	-76	94	109
Residential	Total PCB Congeners	-22	36	-76	83	90
Residential	Total PCBs Congeners (TEQ) - mammalian 2005 TEFs	-84	67	11	103	110
Residential	PCB077	11	32	-71	82	90
Residential	PCB081	-32	-153	-149	-153	-112
Residential	PCB105	-1	33	-72	82	89
Residential	PCB106 & 118	-27	30	-74	78	86
Residential	PCB126	6	-82	-109	-52	-42
Residential	PCB169	27	-155	-160	-155	-115
Residential	Aldrin	-47	0	-56	66	124
Residential	Dieldrin	-79	0	-71	72	129
Residential	gamma-Hexachlorocyclohexane	-96	0	6	52	112
Residential	Total Chlordane	-114	0	-28	60	65
Residential	4,4'-DDD	-105	0	-134	82	136
Residential	4,4'-DDT	-21	0	0	42	105
Residential	Sum DDD	-60	0	-84	72	129
Residential	Sum DDE	-105	0	-54	65	123
Residential	Sum DDT	-21	0	0	42	105
Residential	Total DDTs	-110	0	-29	59	119
Residential	Benzo(a)pyrene	-12	6	-103	56	70
Residential	Naphthalene	92	-17	-69	-1	5
Residential	Total Carcinogenic PAHs	104	128	-2	151	156
Residential	Total PAHs	-21	-4	-129	39	51
Residential	Bis(2-ethylhexyl) phthalate	-62	11	6	30	31
Residential	Hexachlorobenzene	-196	-191	-196	-181	-161
Residential	Total organic carbon	-77	-5	100	100	49
Residential	Total organic carbon	17	90	83	126	129
Residential	Total suspended solids	-85	-22	100	100	40
Residential	Total suspended solids	-159	10	-78	106	116

Note: The values presented in these tables are preliminary and will change slightly before the final draft. The values represent calculations made before receiving EPA comments, and will therefore change slightly as EPA comments are incorporated.

Table 7-5. Non-Representative Load Uncertainty Analysis

Basin Area	Unit Flow (L)	Load Type	Loading Rate	Units	Load (g)
Pentachlorobiphenyl - Load to FT37 applying Non-Representative Load to Sampled Basin Only					
WR-384 (Sampled Basin Only)	812,000	Non-Representative Basin Weighted Mean Composite Water Based	1,258,901	pg/L	1.02
FT37 (not including WR-384)	17,938,000	Heavy Industrial Basin Weighted Mean Composite Water Based	40,351	pg/L	0.72
Total	18,750,000				1.75
Pentachlorobiphenyl - Load to FT37 applying Non-Representative Load to Entire Property					
WR-384 Schnitzer property (applied load)	5,570,000	Non-Representative Basin Weighted Mean Composite Water Based	1,258,901	pg/L	7.01
FT37 not including Schnitzer Property	13,180,000	Heavy Industrial Basin Weighted Mean Composite Water Based	40,351	pg/L	0.53
Total	18,750,000				7.54
				Percent Reduction	0.77

Table 7-5. Non-Representative Load Uncertainty Analysis

Basin Area	Unit Flow (L)	Load Type	Loading Rate	Units	Load (g)
4,4 DDT - Load to FT20 applying Non-Representative Load to Sampled Basin Only					
WR-96 (Sampled Basin Only)	167,000	Non-Representative Basin Weighted Mean Composite Water Based	1.66	µg/L	0.28
OF-22B (Sampled Basin = Applied Load)	1,279,000	Non-Representative Basin Weighted Mean Composite Water Based	0.029166667	µg/L	0.04
FT20 (not including WR-96 and OF-22B)	3,051,950	Heavy Industrial Basin Weighted Mean Composite Water Based	0.005779186	µg/L	0.02
	24,000	Major Transportation Basin Weighted Mean Composite Water Based	0.000495163	µg/L	0.00
	249,050	Parks and Open Space Basin Weighted Mean Composite Water Based	3.21328E-05	µg/L	0.00
Total	18,750,000				0.31
4,4 DDT - Load to FT20 applying Non-Representative Load to Entire Property					
WR-96 Entire Property (Applied Load)	2,112,000	Non-Representative Basin Weighted Mean Composite Water Based	1.66	µg/L	3.51
OF-22B (Sampled Basin = Applied Load)	1,279,000	Non-Representative Basin Weighted Mean Composite Water Based	0.029166667	µg/L	0.04
FT20 (not including WR-96 and OF-22B)	1,106,950	Heavy Industrial Basin Weighted Mean Composite Water Based	0.005779186	µg/L	0.01
	24,000	Major Transportation Basin Weighted Mean Composite Water Based	0.000495163	µg/L	0.00
	249,050	Parks and Open Space Basin Weighted Mean Composite Water Based	3.21328E-05	µg/L	0.00
Total	18,750,000				3.54
				Percent Reduction	0.91

Table 7-5. Non-Representative Load Uncertainty Analysis

Basin Area	Unit Flow (L)	Load Type	Loading Rate	Units	Load (g)
Benzo(a)pyrene - Load to FT34 applying Non-Representative Load to Sampled Basin Only					
Basin L/WR-20 (Sampled Basin Only)	962,000	Non-Representative Basin Weighted Mean Composite Water Based	2.1925	µg/L	2.11
FT34 (not including Basin L/WR-20))	5,139,240	Heavy Industrial Basin Weighted Mean Composite Water Based	0.061797781	µg/L	0.32
	1,625,760	Light Industrial Basin Weighted Mean Composite Water Based	0.032749654	µg/L	0.05
	227,000	Parks and Open Space Basin Weighted Mean Composite Water Based	0.00225	µg/L	0.00
Total	18,750,000				2.48
Benzo(a)pyrene - Load to FT34 applying Non-Representative Load to Entire Property					
Basin L/WR-20 (Applied Load)	1,485,000	Non-Representative Basin Weighted Mean Composite Water Based	2.1925	µg/L	3.26
FT34 (not including Basin L/WR-20))	4,626,700	Heavy Industrial Basin Weighted Mean Composite Water Based	0.061797781	µg/L	0.29
	1,615,300	Light Industrial Basin Weighted Mean Composite Water Based	0.032749654	µg/L	0.05
	227,000	Parks and Open Space Basin Weighted Mean Composite Water Based	0.00225	µg/L	0.00
Total	18,750,000				3.60
				Percent Reduction	0.31

FIGURES

Stormwater and Sediment Trap Data
Collected in accordance with the Round 3A Stormwater Field Sampling Plan and Addendum

↓

Duplicate Analysis
Compared paired field duplicate/lab replicate and normal results for the subset of samples for which these data are available. Processed duplicates/replicates as detailed in Section 4.3.2.

↓

Categorization of Sites within Land Uses
Evaluated data to determine which are representative of heavy industrial and light industrial land uses, and which may be non-representative per the method detailed in Section 4.3.3. A summary of the non-representative locations for each chemical is included in Table 4-5. Supporting data for the reclassification analysis is included in Appendix C.

↓

Stormwater Working Database
The stormwater working database, Appendix D-1, comprises the final data set for use in the subsequent statistical analysis (after duplicate analysis and categorization of sites within land uses).

↓

Generate Summary Statistics for Composite Water and Sediment Trap Data
Followed the methods detailed in Sections 5 and 6 to generate summary statistics using the Stormwater Working Database for each land use and non-representative location. Summary statistics are included in Appendix D, Table D-2.

Generate Monthly Stormwater Runoff Values
Flow volumes were calculated by the City of Portland Bureau of Environmental Services (BES) using the GRID model, as explained in Appendix B.

↓

Calculate Estimated Composite Water and Sediment Trap Based Loads
For composite water, chemical concentrations (mass chemical/volume water) were multiplied by the volume of water discharging at the location over a set time to yield a chemical load in mass/time as detailed in Section 4.5.1.

For sediment trap based loads, chemical concentrations measured in sediment traps (mass chemical/mass sediment) were multiplied by TSS concentrations (mass sediment/volume water sample) measured in composite water samples and the volume of water discharging at the location over a set time to yield a chemical load in mass/time as detailed in 4.5.2.

Composite Water and Sediment Trap Based Loads for each FT model cell are included in Appendix D, Table D-3a and D-3b.

Figure 4-1
Portland Harbor RI/FS
Stormwater Loading Calculations Methods
Stormwater Loading Method Calculation Steps

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N

0 500 1,000 1,500 2,000 Feet

Map Features:

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

2007 Stormwater Sampling Basin Land Use
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Hybrid Model Cells
- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

NOTE:
In summer 2008, St. Johns Bridge outfall identified as WR-510.

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Figure 4-2a
Portland Harbor RI/FS
Round 3A and 3B Stormwater and Sediment Trap Sampling Locations
Lower Willamette Group
River Mile 02 to 05

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LWG LOWER WILLAMETTE GROUP

0 500 1,000 1,500 2,000 Feet

Map Features:

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

2007 Stormwater Sampling Basin Land Use
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Hybrid Model Cells
- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

NOTE:
In summer 2008, St. Johns Bridge outfall identified as WR-510.

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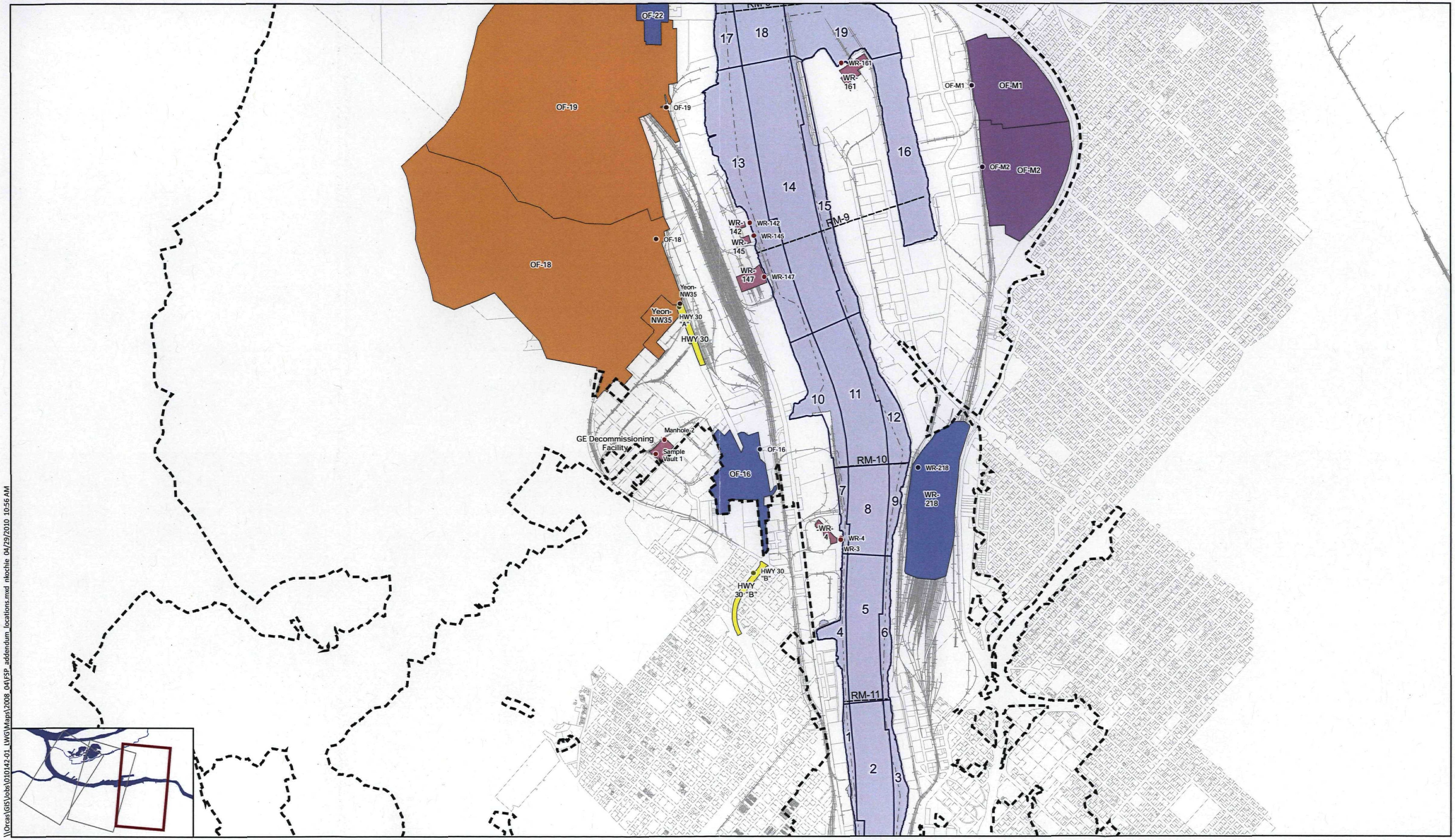
Figure 4-2b
Portland Harbor RI/FS
Round 3A and 3B Stormwater and Sediment Trap Sampling Locations
Lower Willamette Group
River Mile 05 to 08



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LWG LOWER WILLAMETTE GROUP

0 500 1,000 1,500 2,000 Feet

Map Features:

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

2007 Stormwater Sampling Basin Land Use
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Hybrid Model Cells
- Approx. Drainage Boundary
- Navigation Channel
- Waterfront Taxlots
- River miles

FEATURE SOURCES:
Land Use/Zoning, Streams, Water Bodies: Metro RLIS.
Channel & River miles: US Army Corps of Engineers.

NOTE:
In summer 2008, St. Johns Bridge outfall identified as WR-510.

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Figure 4-2c
Portland Harbor RI/FS
Round 3A and 3B Stormwater and Sediment Trap Sampling Locations
Lower Willamette Group
River Mile 08 to 11

Figure 4-3. Replicate/Duplicate Outlier Analysis Flow Chart

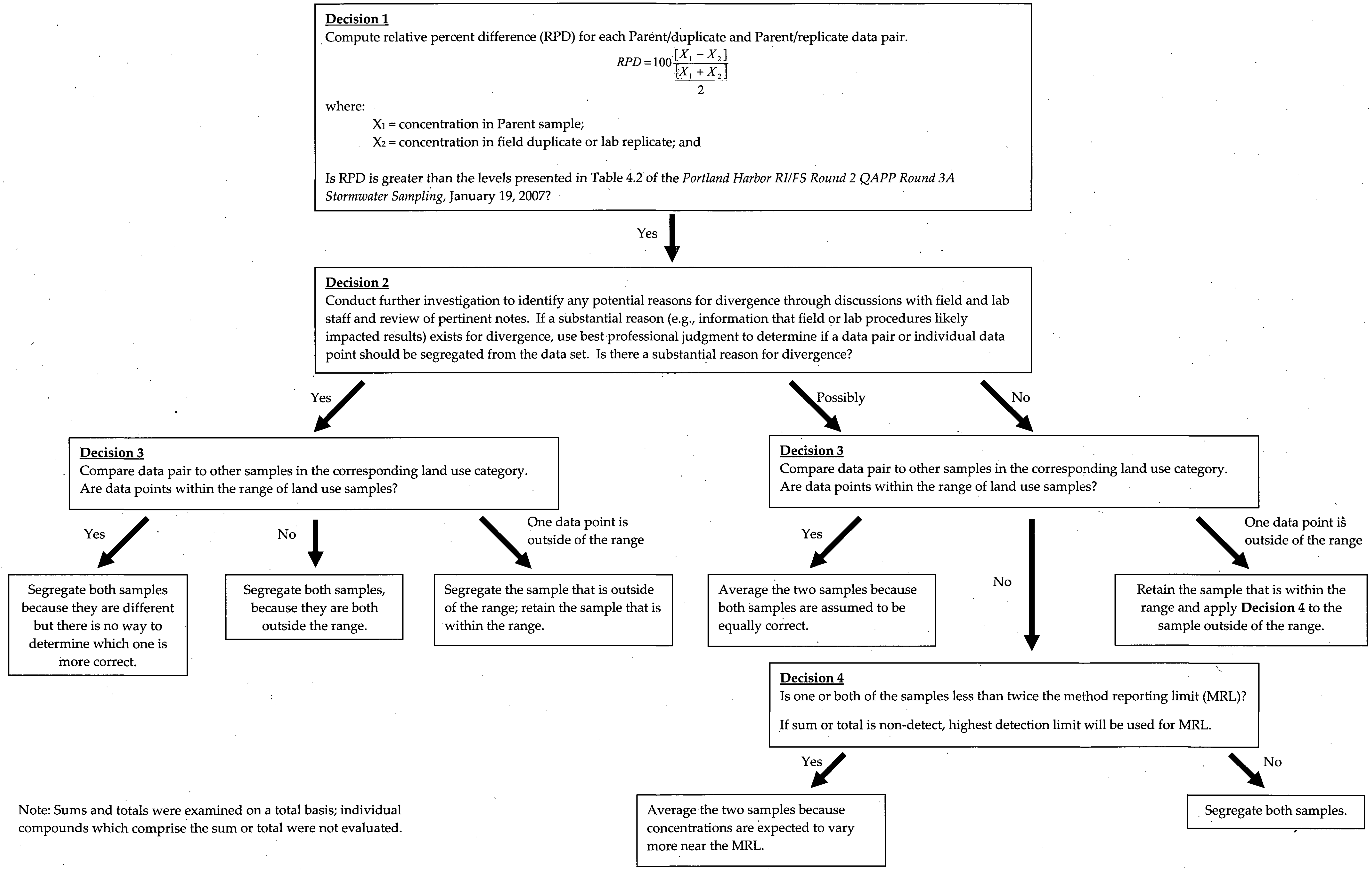

Figure 4-4 – Reclassification Analysis Flow Chart

Step 1 – Assess Representative Location Type Classification

1. A. Graphical Analysis.
Create box plots, histograms, and QQ Plots for Representative records for each analyte and Location Type (i.e. heavy industrial) on a lognormal scale. Plot according to the following rules per ProUCL graphing options:
  a. Box plots: non-detect (ND) = detection limit (DL)
  b. QQ Plots: ND = ½ DL and ND excluded.
Are there potential outliers from graphical analysis?

Yes

Remove potential outliers from data set. Return to Graphical Analysis step to identify any potential outliers that may have been masked by extreme outliers.

No

1.B. Conduct Goodness-of-Fit (GOF) Tests.
Run GOF Tests.

Does data fit Normal Distribution per ProUCL statistical tests (e.g. Shapiro-Wilk) at 5% significance level?

Yes

1.C. Conduct Outlier Tests.
Conduct statistical outlier tests per ProUCL. Perform tests using the following options available in ProUCL:
  a. ND = ½ DL, and
  b. ND Excluded
Are any outliers identified at the 5% significance level?

Step 1.C. Outlier Test Results are shown in Column E of Table 4-2.

No

Yes

No

Remove statistical outliers from dataset.
  a. Perform graphical analysis (as detailed above in 1.A.).
  b. Confirm additional potential outliers do not mask any additional outliers.
  c. Conduct GOF Tests (as detailed above in 1.B.).
Does data fit Normal Distribution per ProUCL statistical tests (e.g. Shapiro-Wilk) at 5% significance level?

Yes

No

Do not remove outliers determined during Outlier Tests.

1.D. Reclassify locations from Representative to Non-representative.
Identify sample results identified as outliers in previous steps. Is the number of outliers for a specific location equal to or greater than 50% for a specific analyte?

Step 1.D. Reclassification Results are shown in Column F of Table 4-2.

Yes

Reclassify Location Type as Non-representative.

No

Retain Location Type as Representative.

Step 2 – Reclassification from "Non-representative" to "Representative"
Step 2 starts with the data as classified in Step 1.

Do all of the results for a chemical at a Location Type fall within the Representative range of observed values for that chemical analyzed at the Representative Location Type with a 100% screening factor?

Step 2. Reclassification Results, the Final Location Type, are shown in Column G of Table 4-2.

Yes. All results are within the observed range.

If all results are within the observed Representative range, then the Location Type associated with that chemical and location will be re-categorized as Representative Location Type.

No

If there is at least one data point outside of the Representative range on the high end, then the Location Type will remain classified as Non-representative. On the low end, if all data points are outside of the Representative range then the data will be reclassified as Non-representative.

Note: Classification of data was conducted on total concentrations and dissolved concentrations follow total classifications.

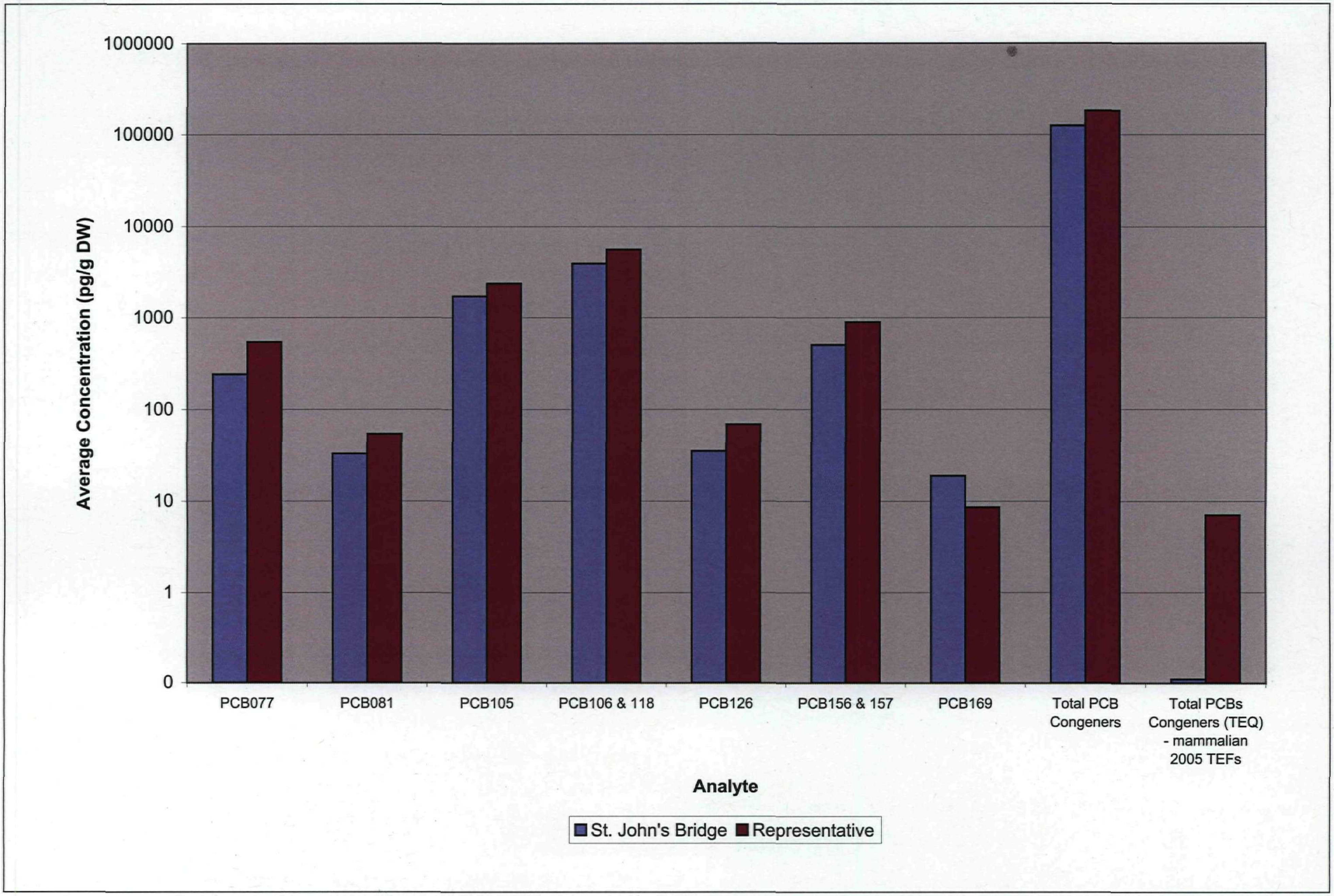

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Figure 4-5
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge versus Major Transportation
PCB Sediment Trap Data

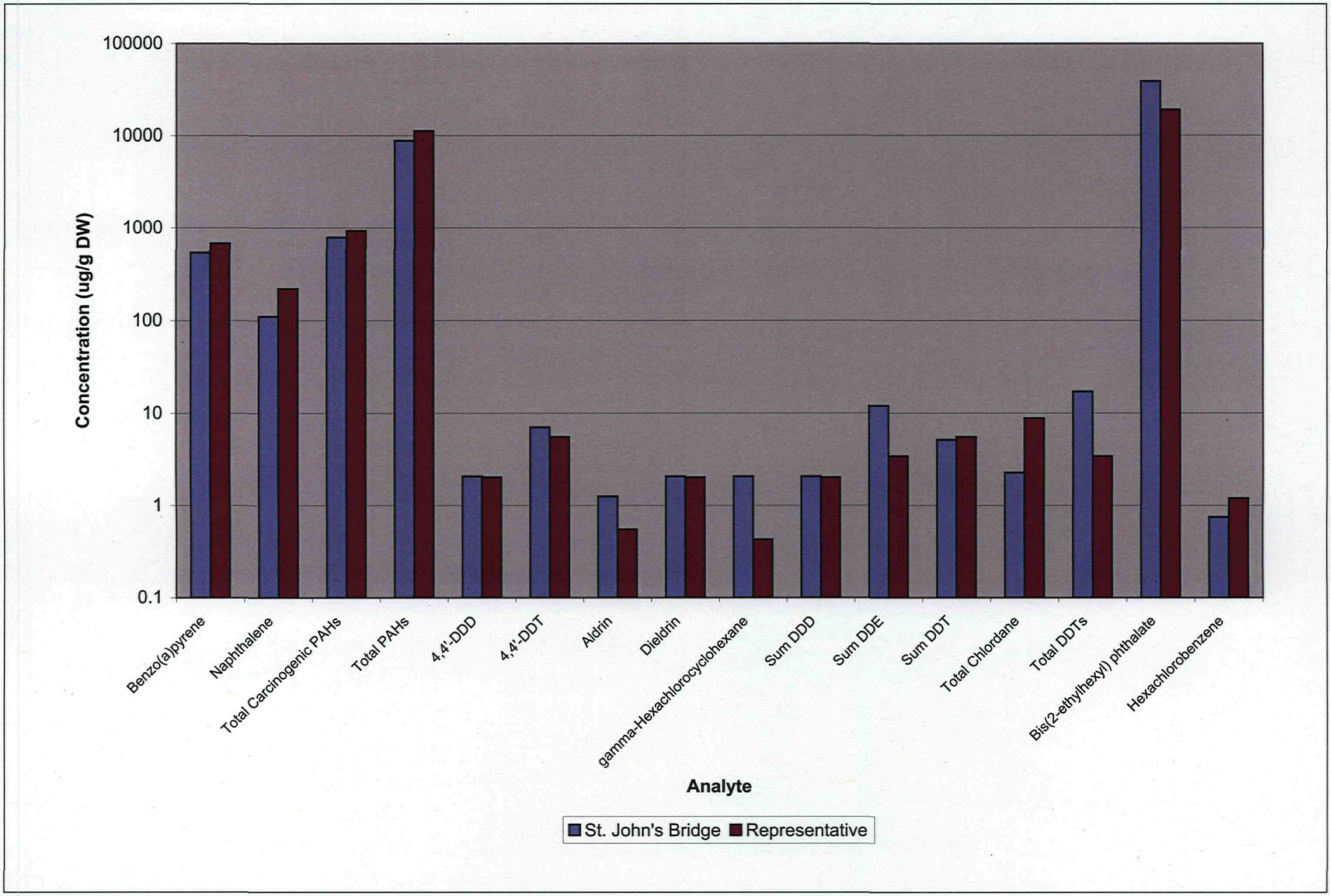

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Figure 4-6
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge versus Major Transportation
Organics Sediment Trap Data

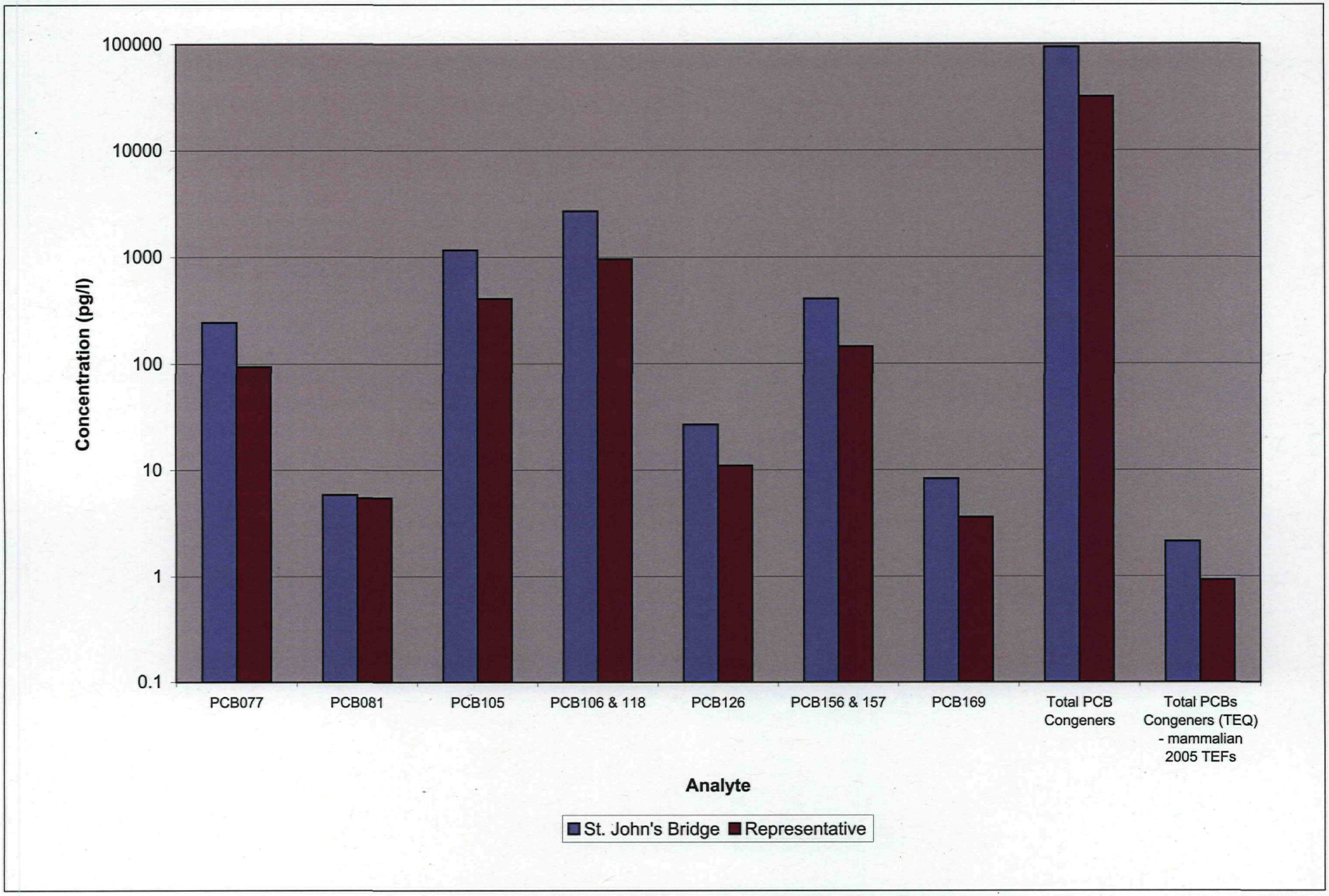

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Figure 4-7
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge versus Major Transportation
PCB Composite Water Data

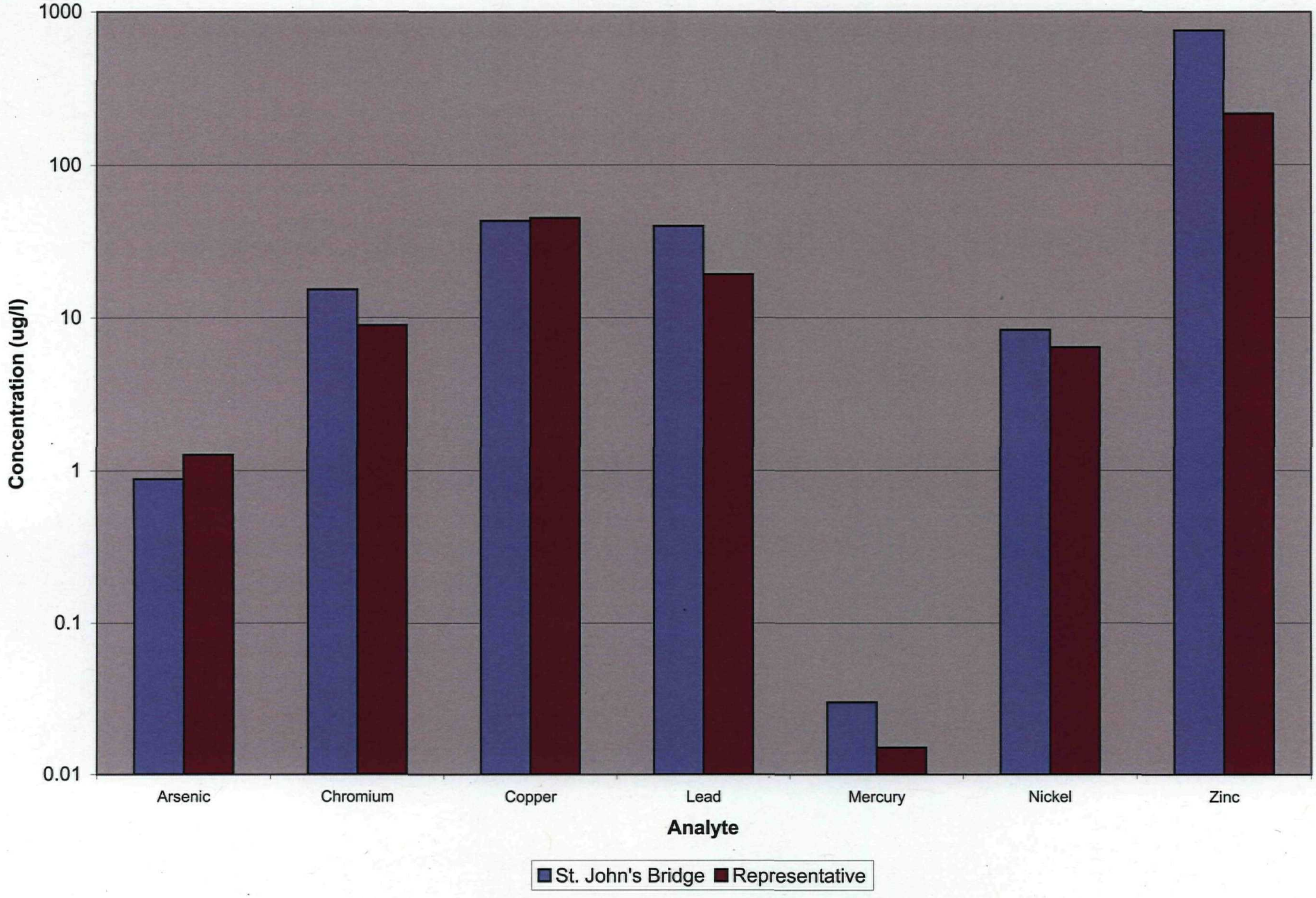

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Figure 4-8
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge versus Major Transportation
Metals Composite Water Data

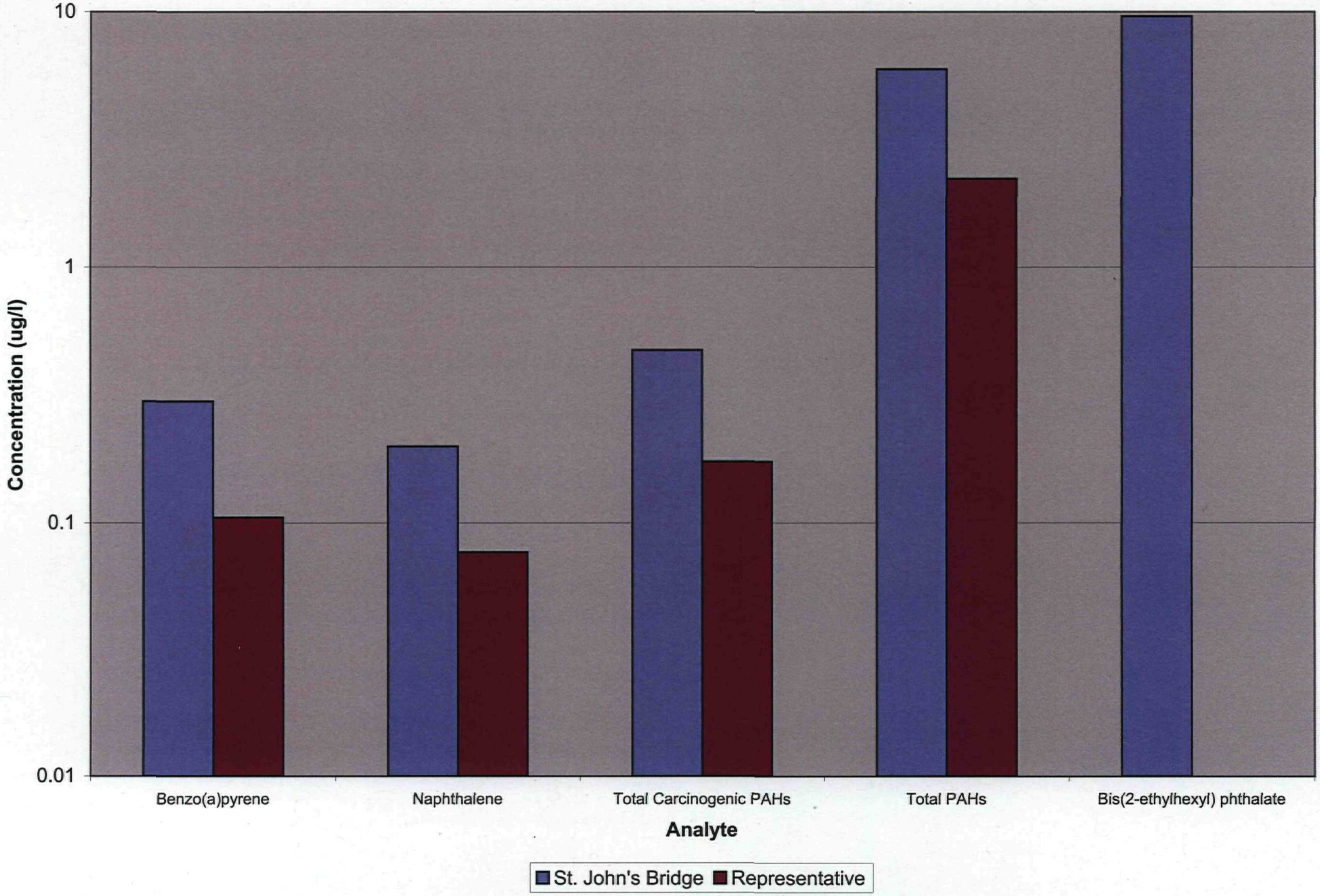

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Figure 4-9
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge versus Major Transportation
Organics Composite Water Data

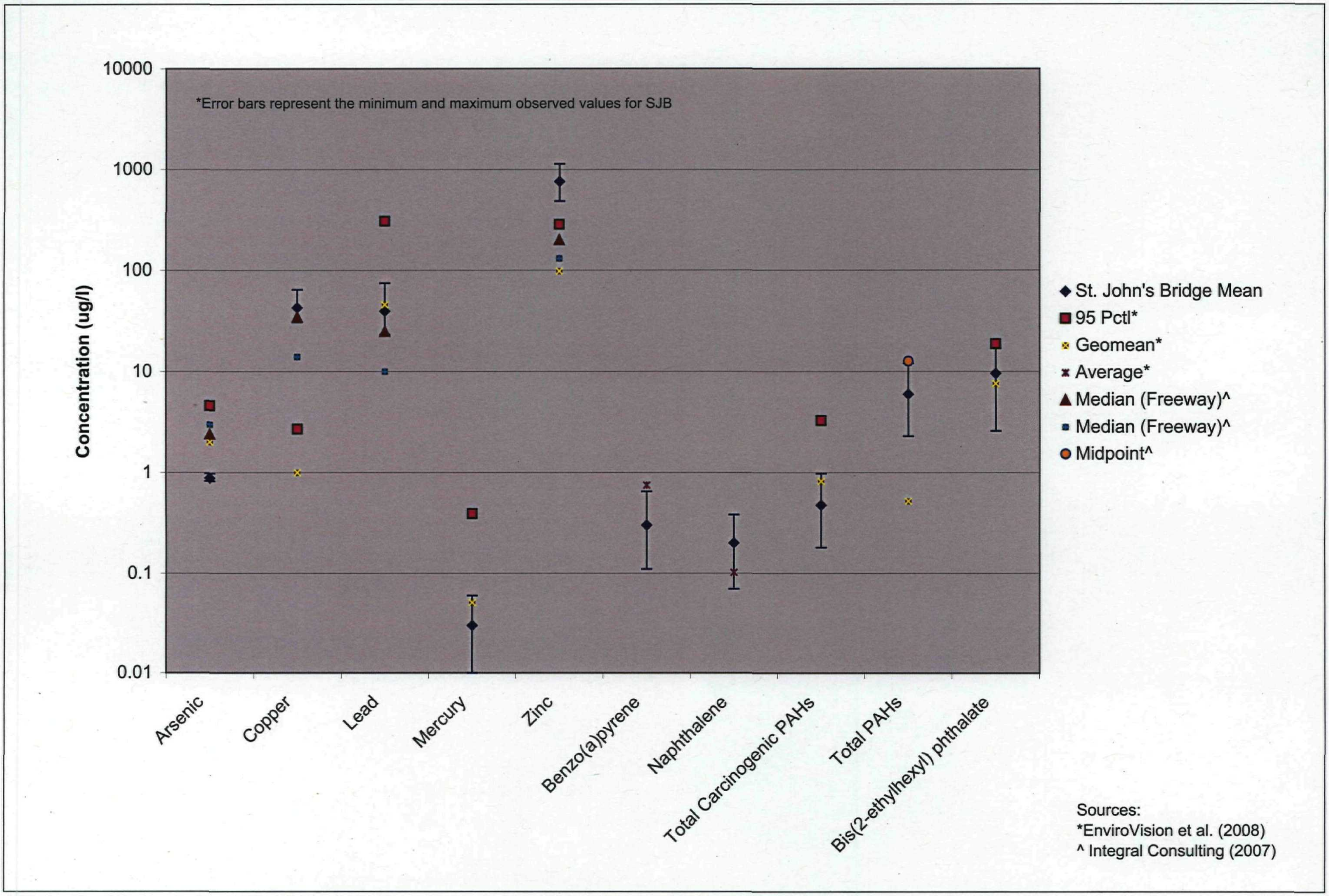

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Figure 4-10
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
St. Johns Bridge Data versus Literature Values

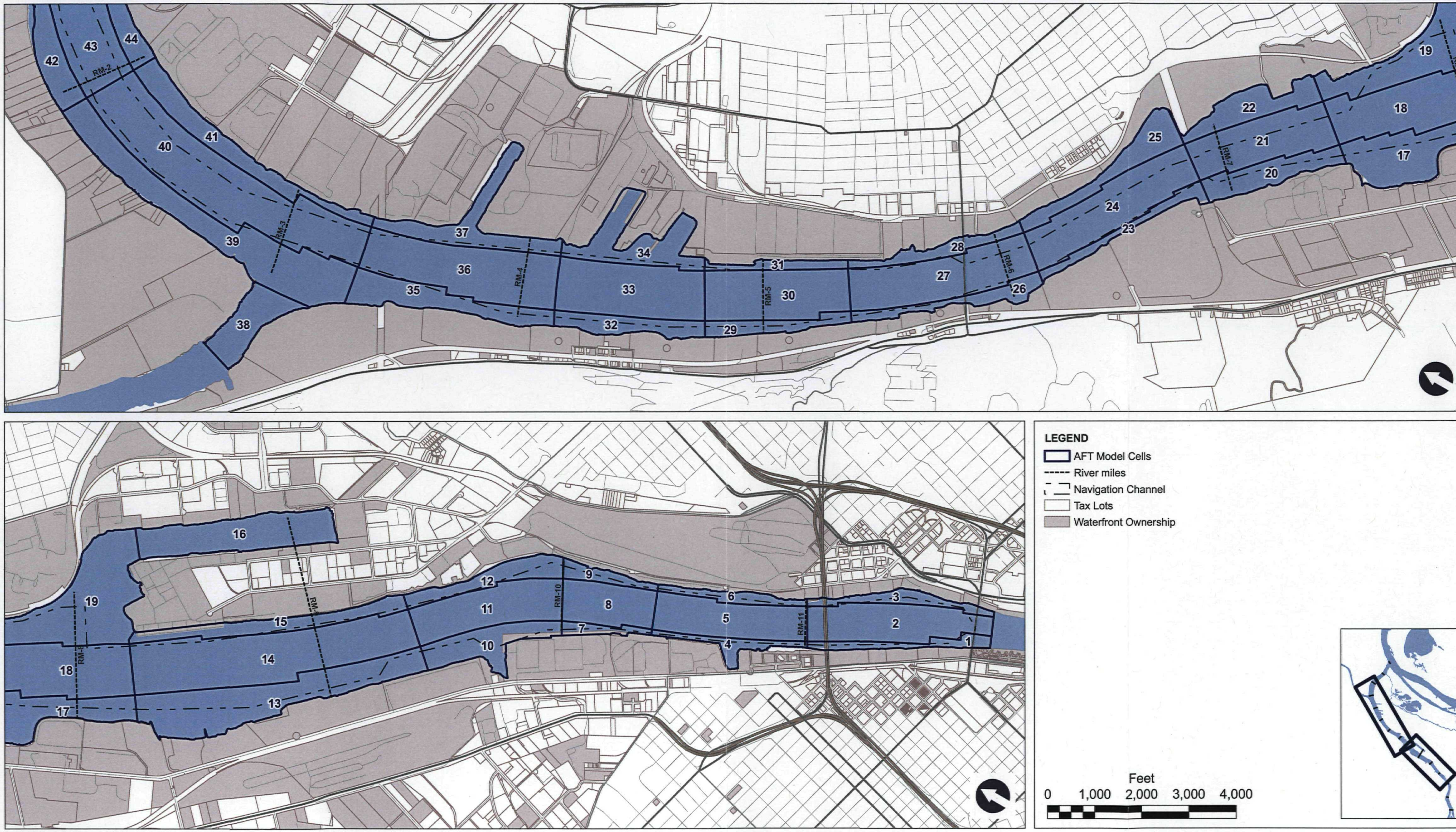

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Figure 4-11
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Hybrid Model Domain and Cells
River Mile 02 to 11

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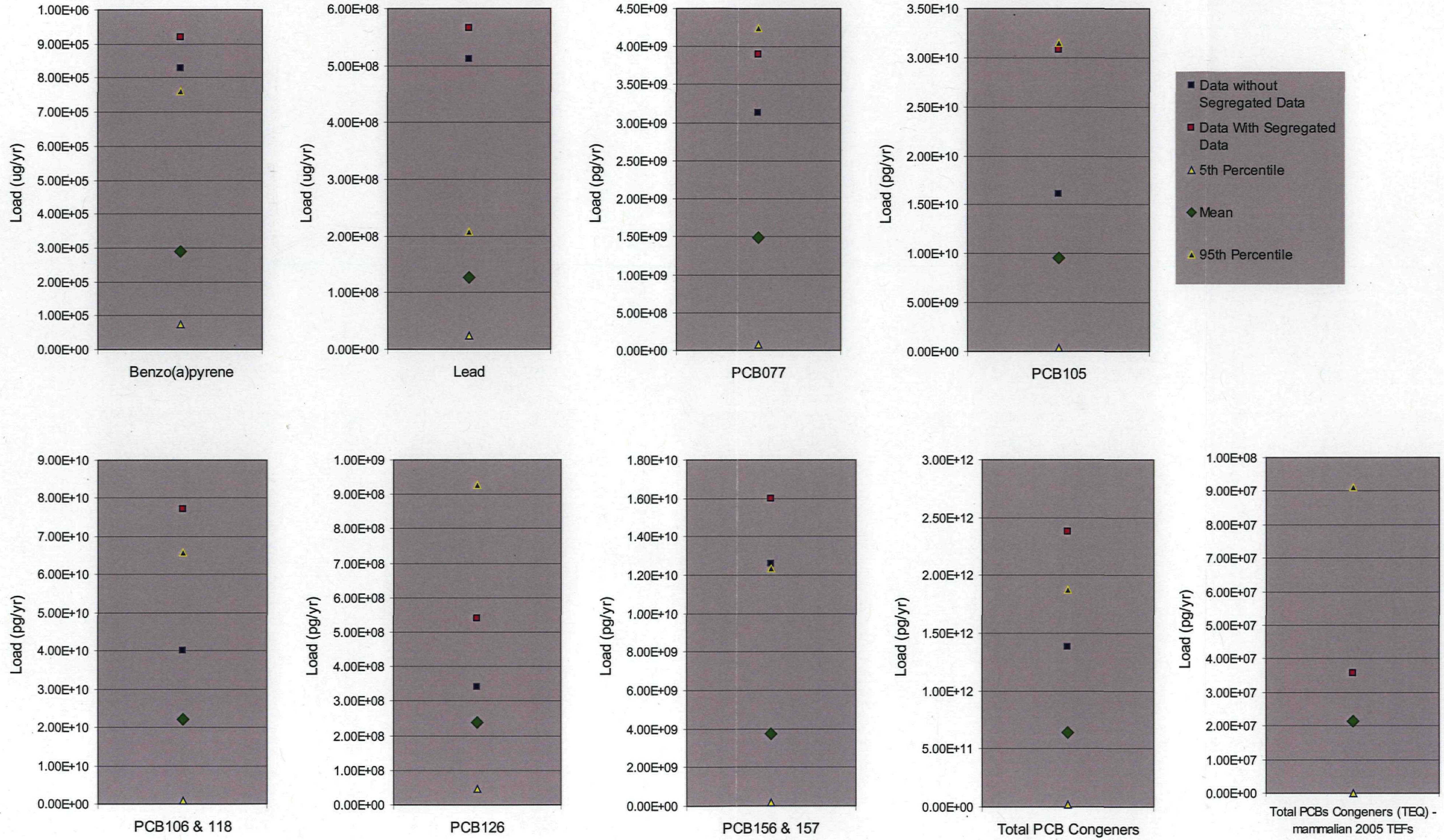

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Figure 7-1
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Plots of Stormwater Uncertainty Evaluation
Evaluation of Segregated Samples at OF-18

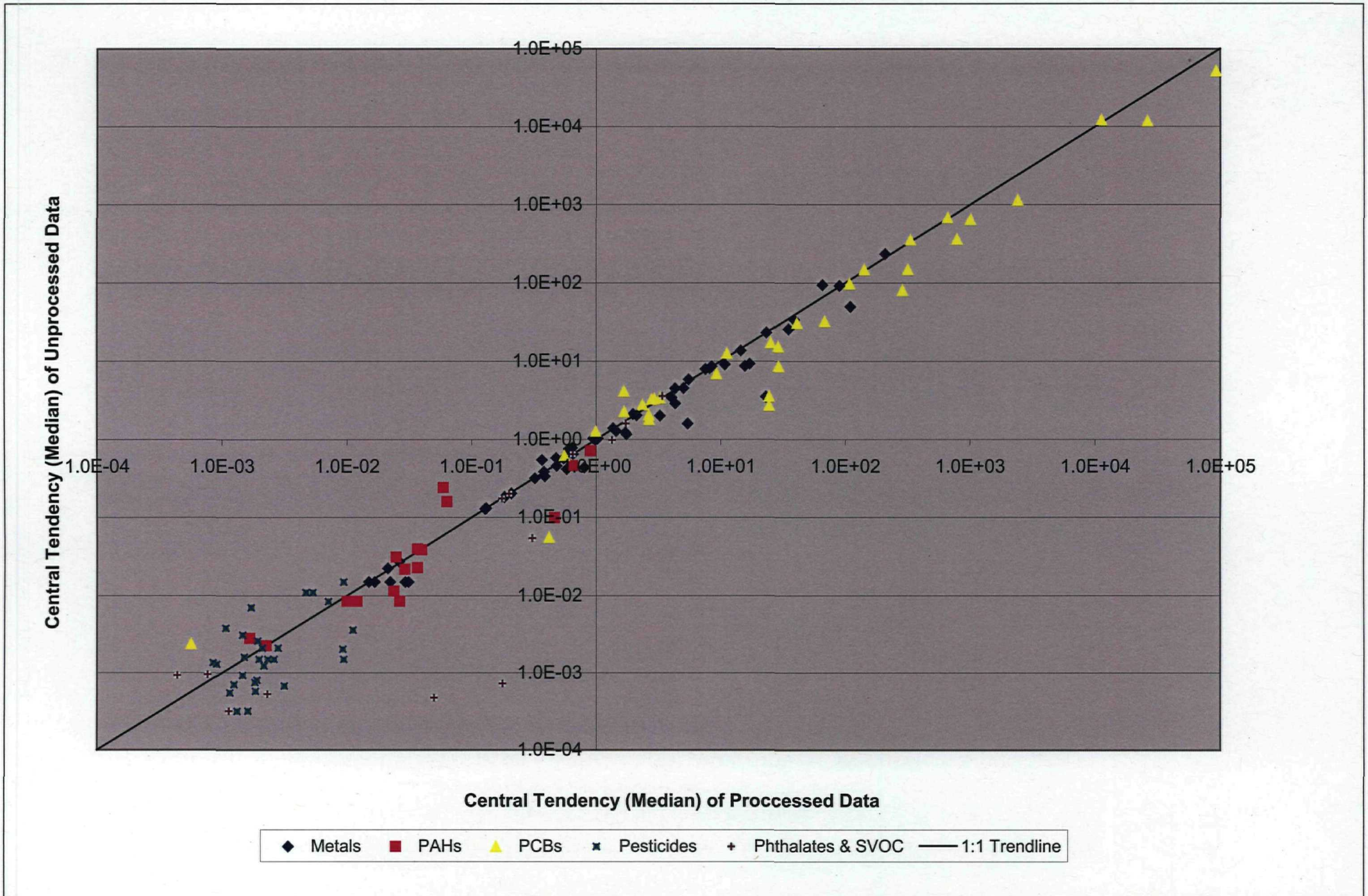

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Figure 7-2
Portland Harbor RI/FS
Stormwater Loading Calculations Methods
Plot of Stormwater Uncertainty Evaluation, Median Comparison Between Processed and Unprocessed Data
Evaluation of Segregated Samples at OF-18

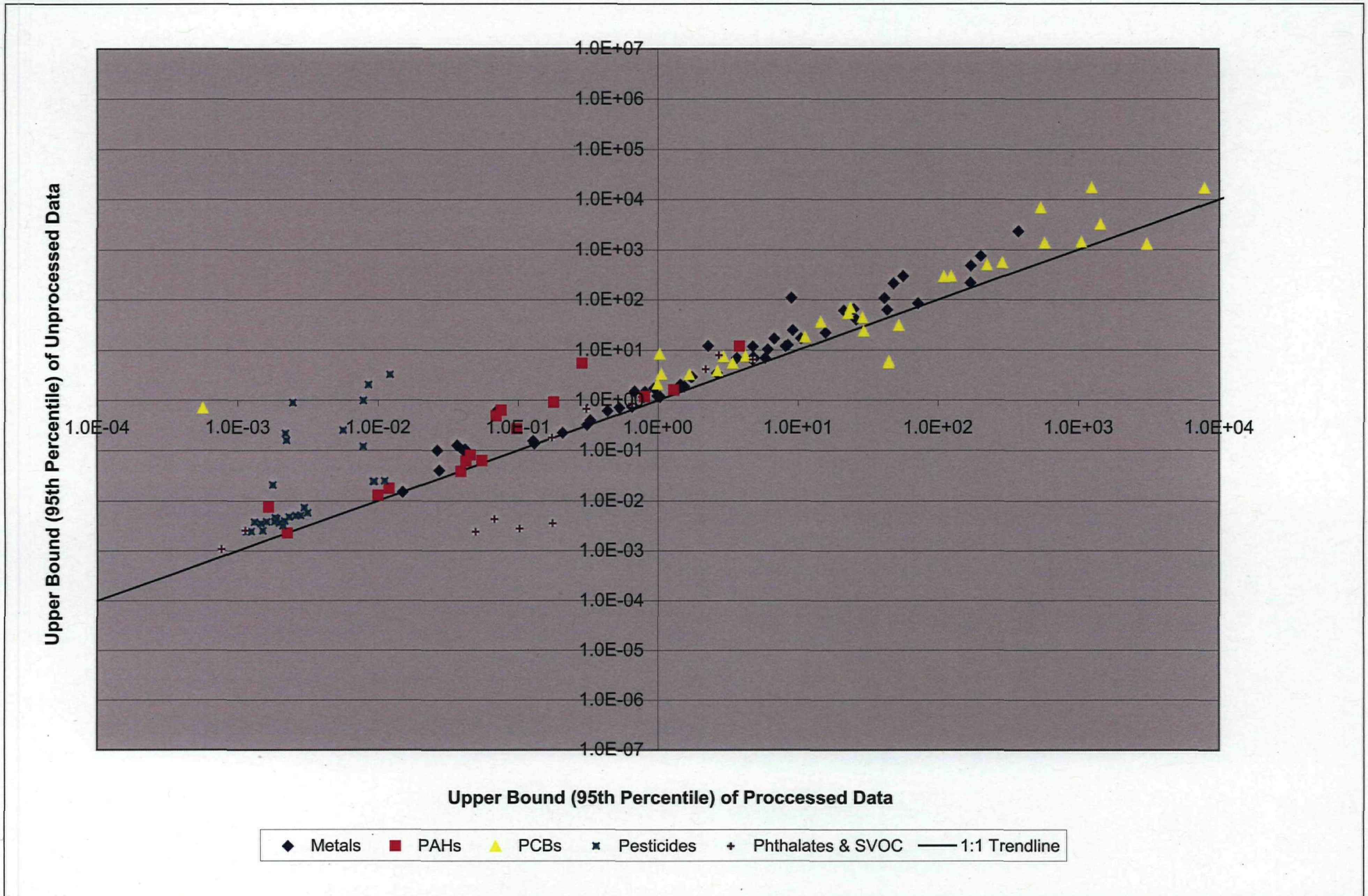

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Figure 7-3
Portland Harbor RI/FS
Stormwater Loading Calculations Methods
Plot of Stormwater Uncertainty Evaluation, Upper Bound Comparison Between Processed and Unprocessed Data
Evaluation of Segregated Samples at OF-18

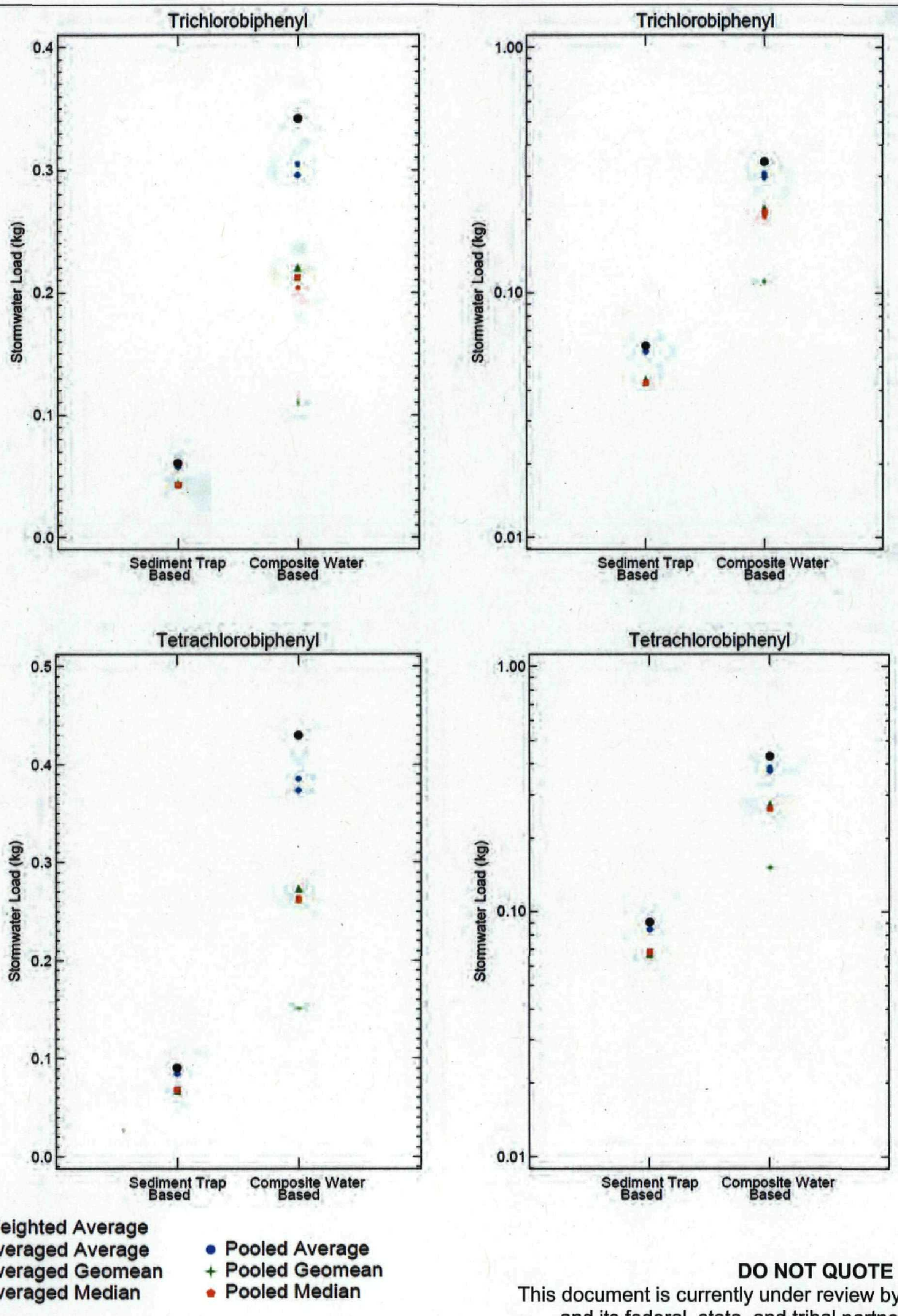

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Figure 7-4a
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

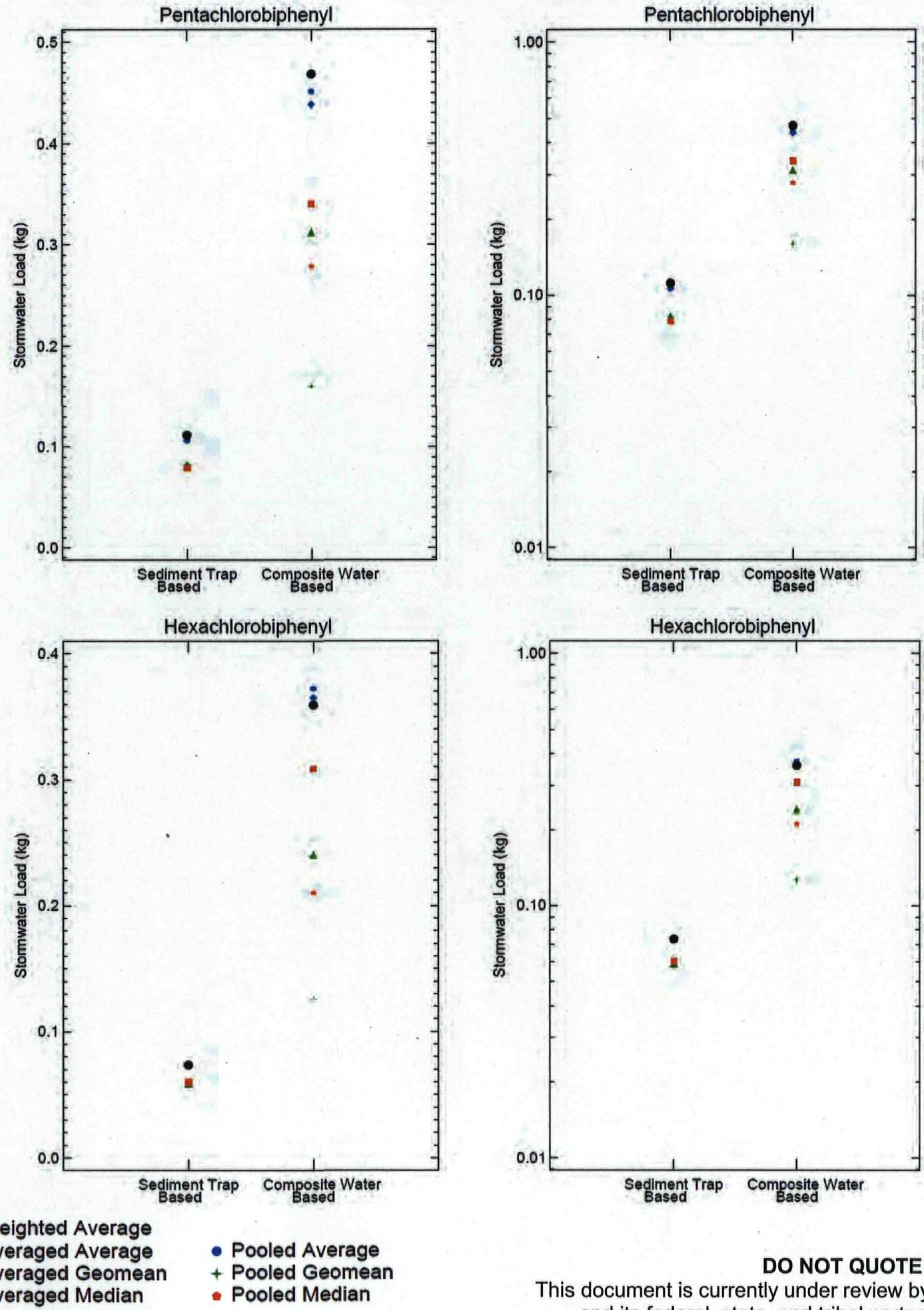

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Figure 7-4b
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

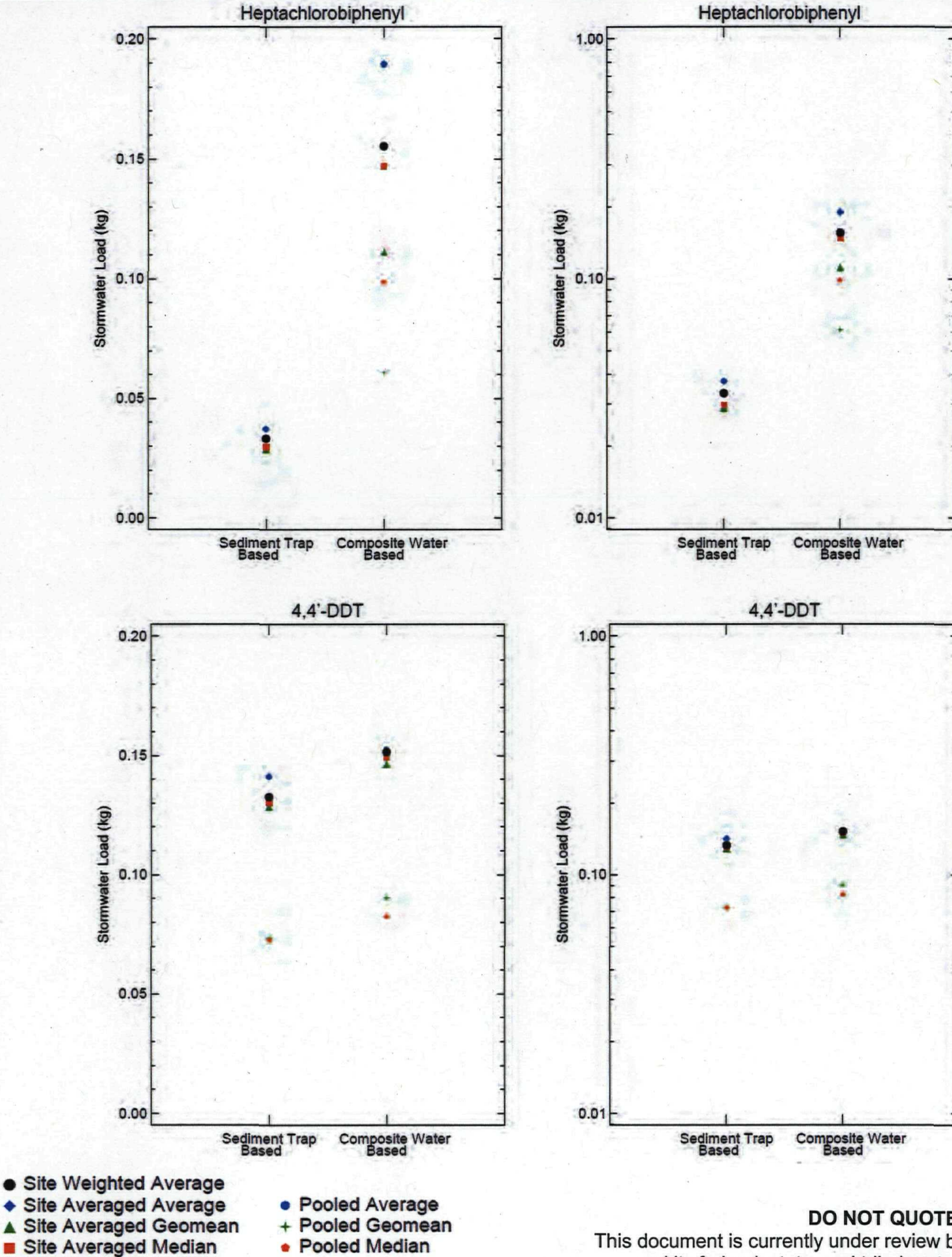

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Figure 7-4c
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

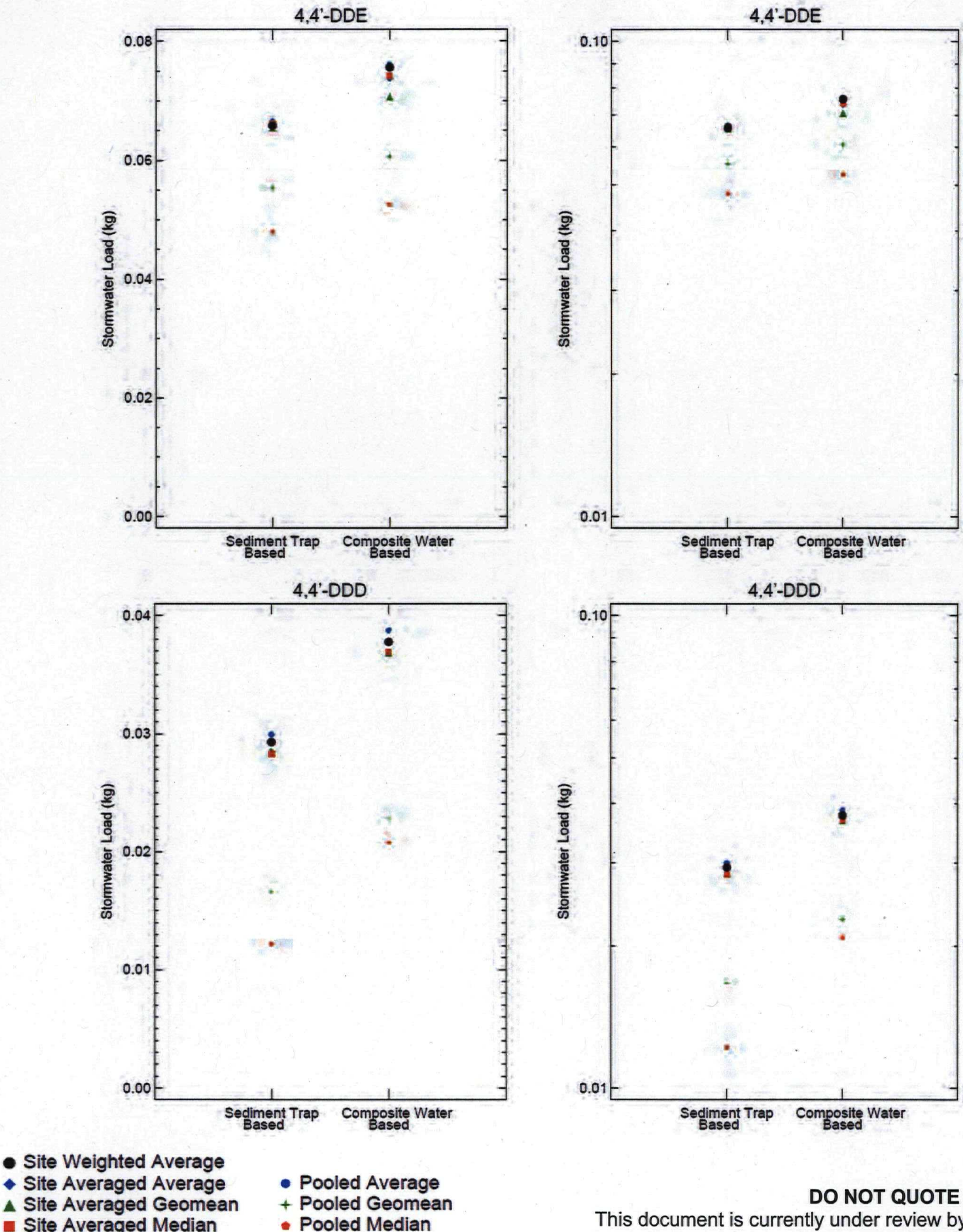

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Figure 7-4d
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

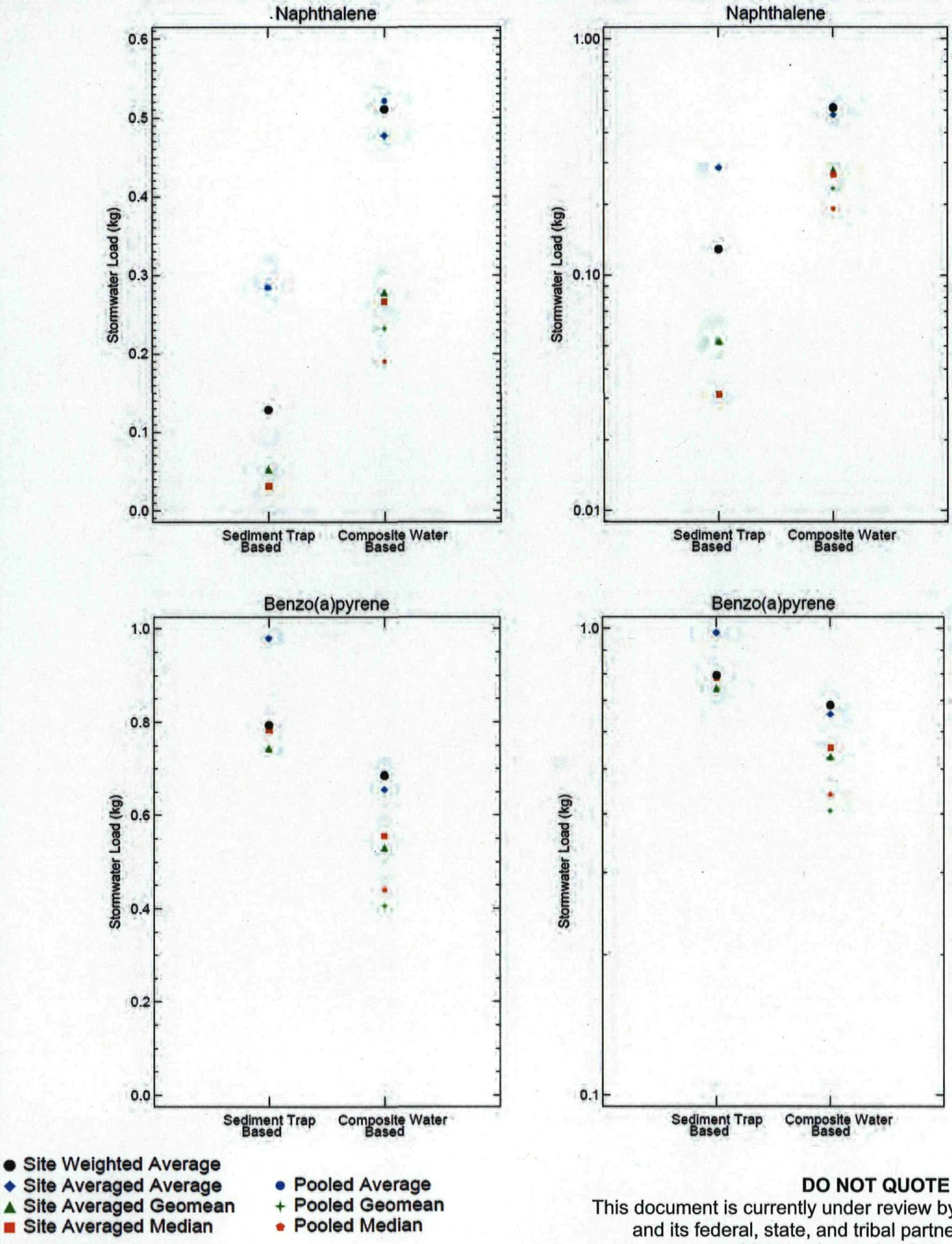

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Figure 7-4e
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

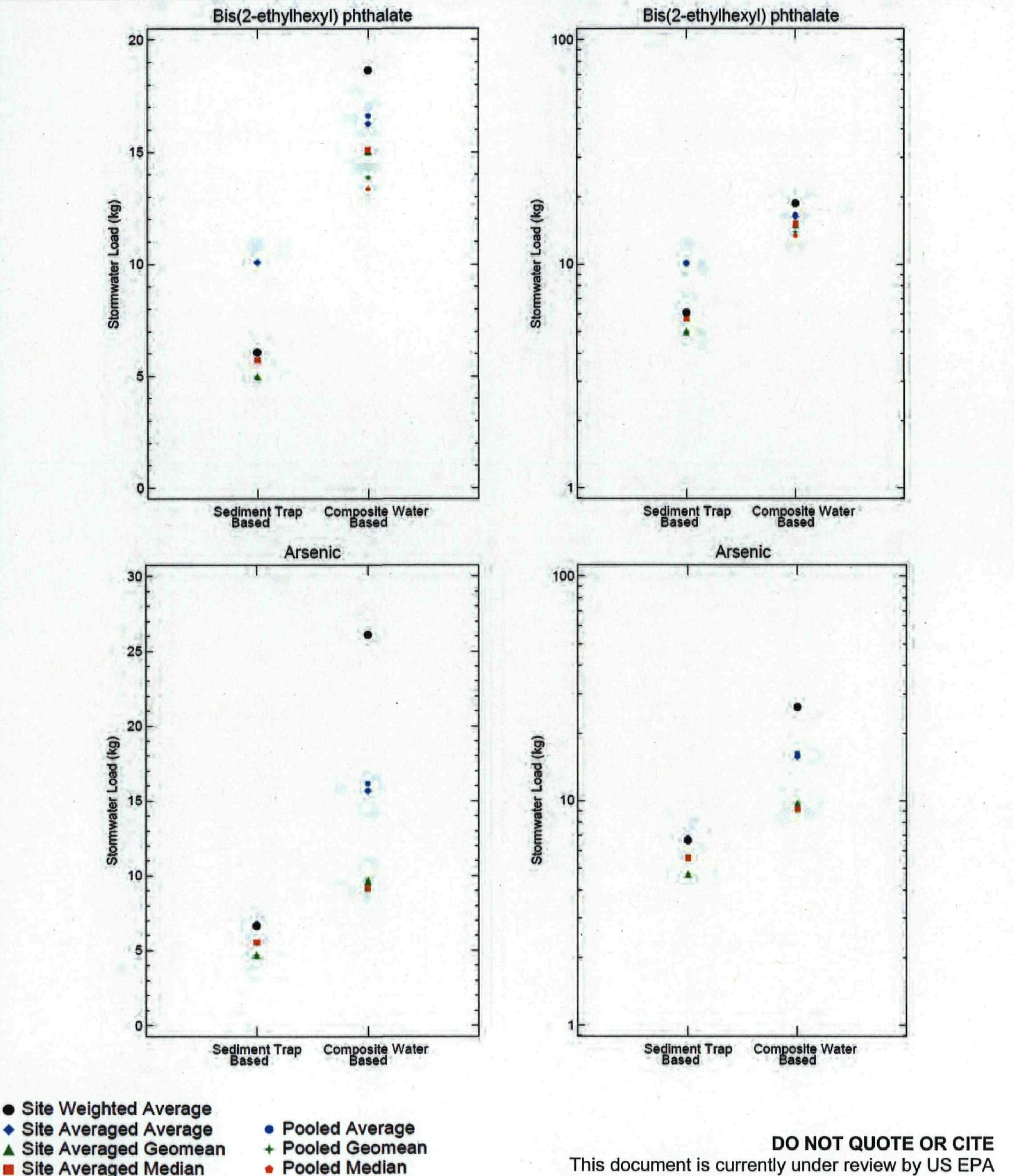

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Figure 7-4f
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

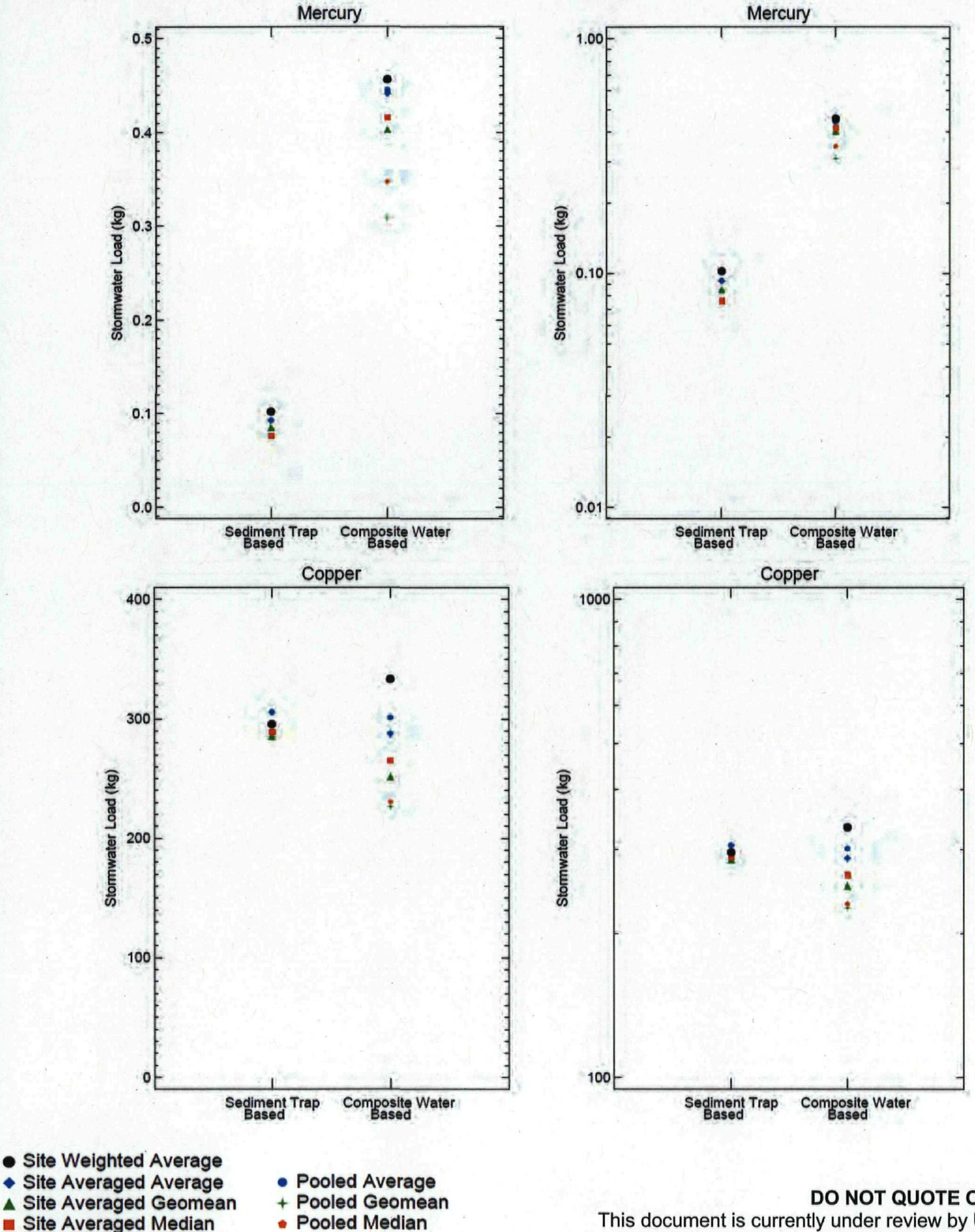

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Figure 7-4g
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of Sediment Trap Based Loads versus Composite Water Based Loads

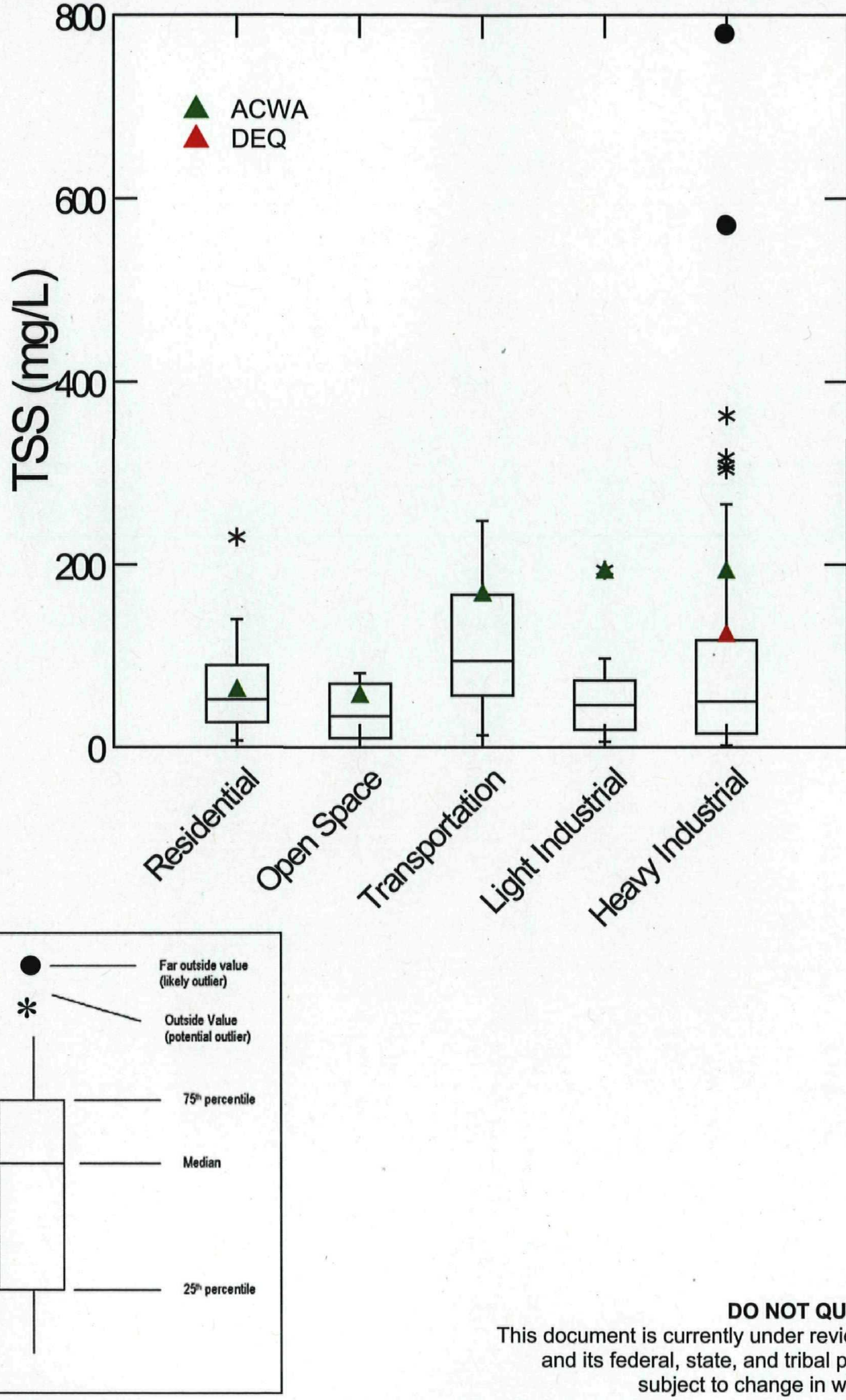

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Figure 7-5
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Comparison of LWG TSS Data to Literature Data

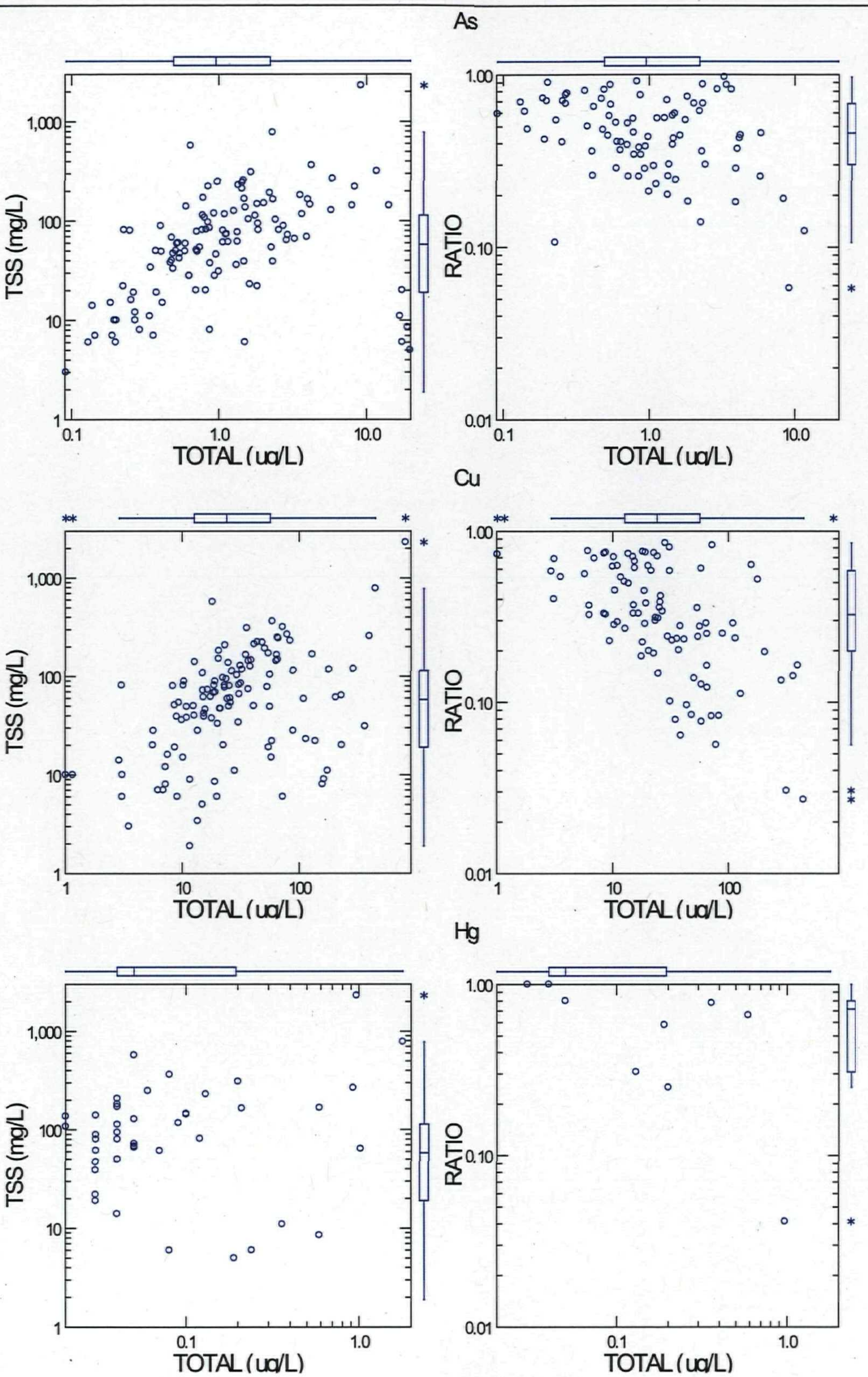

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Figure 7-6
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Metals Ratio versus Total Concentration and TSS vs. Total Concentration
LWG Stormwater Composite Data

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Figure 7-7a
Portland Harbor RI/FS
WR-384 Uncertainty Analysis
Lower Willamette Group

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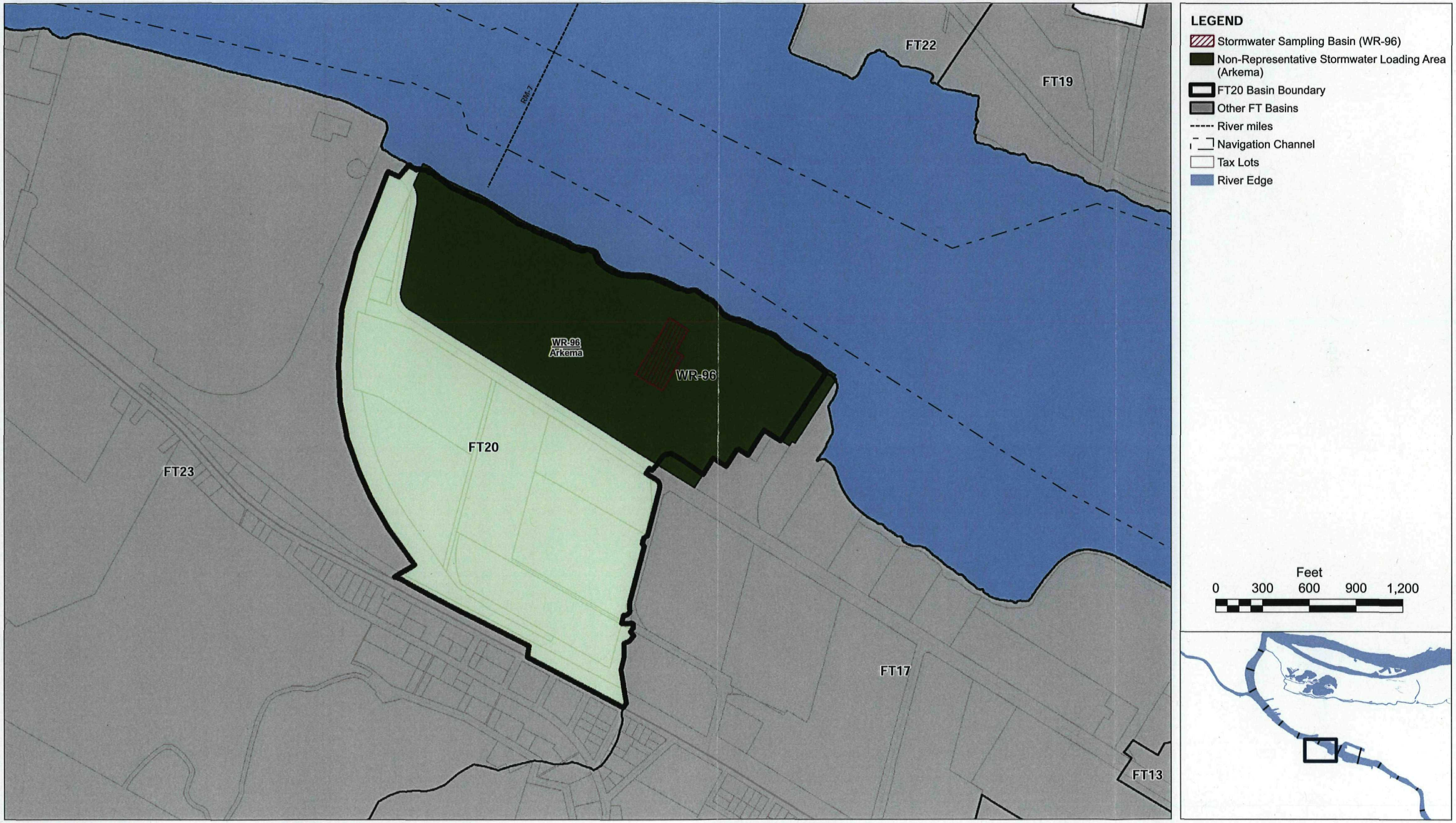

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Figure 7-7b
Portland Harbor RI/FS
WR-96 Uncertainty Analysis
Lower Willamette Group

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Figure 7-7c
Portland Harbor RI/FS
Basin L/WR-20 Uncertainty Analysis
Lower Willamette Group

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AMEC 2008b. November 2007 Storm Water Monitoring Report. Prepared for GE Energy. AMEC Earth and Environmental, Portland, OR. May 2008

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APPENDIX A

ADMINISTRATIVE RECORD

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

TARGET SHEET

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Document ID #: 1356981

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Portland Harbor RI/FS Stormwater Loading Calculation Methods Report Appendix A Administrative Record
January 31, 2011

APPENDIX B
DESCRIPTION OF GRID MODEL AND RUNOFF VOLUME CALCULATIONS

1.0 Introduction

As discussed in Section 5.2 of the main body of this report, runoff volumes were calculated using the City of Portland Bureau of Environmental Service's GRID model, for each segment of the river as shown in Figure B-1. The segments shown in Figure B-1 correspond to segments designated for the "Hybrid Model."

2.0 Delineation of River Segment Drainage Basins

Delineation of stormwater drainage to each river segment uses City MS4 delineation information, as well as other, non-City conveyance system information mapped in the City's GIS system. The runoff basins do not include docks. Runoff basins for each of the river segments are shown in Figure B-2.

3.0 Mapping of Impervious Areas

Differentiating between impervious and pervious areas is important because there is generally more runoff from impervious areas compared to pervious areas. The impervious areas were originally derived primarily from aerial imagery dating back to the mid-1990s, although adjustments have been made to this layer specific to the Portland Harbor effort by the City, particularly for the Non-Representative Heavy Industrial sites. The City's Industrial Stormwater group also conducted limited quality assurance at other locations with the study area, based on their site knowledge. This original coverage is used exclusively and extensively for the City's sewer modeling, and as such, its suitability for other purposes is possibly limited, though it represents the best data available at this time. Impervious areas are shown overlaying the land use categories in Figure B-2.

4.0 Runoff from Representative Land Use Categories

Runoff volumes were calculated separately for each land use category, since the data analysis determines different chemical concentrations that are representative of each category. These land use categories, as discussed in Section 4.1 of the main body of this report are:

- Residential
- Major Transportation Corridors
- Heavy Industrial
- Light Industrial
- Parks and Open Space

These land use categories correspond to the City of Portland current zoning as shown below in Table B-1 and Figure B-2, with the exception of three modifications.

- The 28 zoning codes were aggregated to general land use groups for reporting of overall runoff from each group. Table B-1 shows how detailed zoning codes were aggregated, consistent with the *Stormwater Sampling Rationale* and the *Round 3A Stormwater Field Sampling Plan*.
- Major Transportation (highways and freeways), which is not in the City of Portland zoning, was added based on the Portland Office of Transportation's GIS layer showing highways to represent major Oregon Department of Transportation corridors.
- An additional adjustment was made to identify areas (designated as Open Space/Vacant on the map) that are currently identified in the zoning layer as something other than open space but where land use is more representative of open space, using Metro's 2005 Vacant Lands GIS layer. This occurs under several conditions:
  - Forested or vegetated areas that have never been developed (these occur primarily west of Highway 30).
  - Industrial lands that have been remediated, capped, and vegetated.

For industrial zoned areas, most of the polygons associated with zoned industrial areas that were identified as vacant in Metro's Vacant Land's layer were left designated as industrial because these are known historical industrial sites. Additionally, many of the representative industrial land use basins sampled as part of Round 3A and 3B stormwater sampling included some vacant land. Three subareas of zoned industrial land use sites were converted from zoned industrial land use to open space/vacant zoning use based on the areas being remediated and vegetated. These include:

- Gould Superfund site
- McCormick and Baxter Superfund site
- PGE Harborton wetlands (west of current facility)

Also, there were several other small areas that are zoned industrial but were changed to open space/vacant; these were forested areas that abutted Forest Park or vegetated areas that did not appear to have been historically used for industrial activities.

For non-industrially zoned properties, the vacant lands in Metro's layer were used to convert properties to open space/vacant in this new layer unless, using current aerials, it appeared that the property had been cleared and was being otherwise used for non-open space purposes (e.g., parking of vehicles, etc). In these cases, the land use zoning was left with its current designation.

Table B-1. Land Use Categories for Stormwater Loading Calculations.

General Land Use Code	Detailed Zoning Codes	Zoning Description[1]	Notes
IND (Heavy Industrial)	IH	Heavy Industrial	
LIND (Light Industrial)	IG2	General Industrial 2	
	EG1	General Employment 1	
	EG2	General Employment 2	
	EX	Central Employment	
	IG1	General Industrial 1	
TRANS (Major Transportation)	--	Not a zoned area.	This will be State Highways and Freeways derived as an overlay to the zoning layer
RES/COM (Residential and Commercial)	R10	Residential 10,000 sq. ft. lots	Sparse residential and commercial land use within Portland Harbor area but all zoning codes are included in case any of these are within the segment drainage areas.
	R7	Residential 7,000 sq. ft. lots	
	R5	Residential 5,000 sq. ft. lots	
	R3	Residential 3,000 sq. ft. lots	
	R2.5	Residential 2,500 sq. ft. lots	
	R2	Residential 2,000 sq. ft. lots	
	R1	Residential 1,000 sq. ft. lots	
	RX	Central Residential	
	RH	High Density Residential	
	IR	Institutional Residential	
	CG	General Commercial	
	CN1	Neighborhood Commercial 1	
	CN2	Neighborhood Commercial	
	CS	Storefront Commercial	
	CM	Mixed Commercial/Residential	
	CO1	Office Commercial 1	
	CX	Central Commercial	
	CO2	Office Commercial 2	
POS (Parks and Open Space)	OS	Open Space	Includes very low density residential located above Forest Park. This type of land use included in Open Space monitoring station. Also includes Vacant Land that is undeveloped and functions as Open Space.
	RF	Residential Farming	
	R20	Residential 20,000 sq. ft. lots	
	RUR	Rural (Mult Co. zoning code)	

[1]Portland Code Title 33 descriptions of land use zoning at http://www.portlandonline.com/auditor/index.cfm?c=28197

5.0 Runoff Volumes for Non-Representative Heavy Industrial Sites

Calculation of runoff volumes for all Heavy Industrial sites is reported separately, whether they were originally designated as non-representative or representative land use. The determination of whether a heavy industrial site is appropriately designated as Non-Representative was made as described in Section 4.3.3 of the main report. Runoff volumes were calculated separately for each location as listed in Table B-2. The classification or reclassification of non-representative heavy industrial locations were conducted on a location-by-location and chemical-by-chemical basis. It should be noted that many of these locations were not deemed Non-representatiave. However, because runoff volumes needed to be calculated before the chemical data analyses were completed, runoff volumes were calculated for every industrial location. If a location was deemed Non-representative, its runoff volume was subtracted from the appropriate representative land use runoff volumes for each segment, so that loads could be calculated separately.

The particular approaches calculating and apply volumes and loads for various types of heavy industrial sites and basins sampled are detailed more in the following subsections.

5.1 INDIVIDUAL HEAVY INDUSTRIAL LOCATIONS SAMPLED BY LWG

Twelve Heavy Industrial locations, listed below in Table B-2, were sampled by LWG and may be deemed non-representative through the course of stormwater data analyses.

Table B-2. Heavy Industrial Locations.

Location ID	Description
WR-22	OSM
WR-123	Schnitzer International Slip
WR-384	Schnitzer – Riverside
WR-107	GASCO
WR-96	Arkema
WR-14	Chevron – Transportation
WR-161	Portland Shipyard
WR-4	Sulzer Pump
WR-145/142	Gunderson
WR-147	Gunderson (former Schnitzer)
Drains to OF-17	GE Decommissioning
WR-67	Siltronic
WR-218	UPRR Albina
St. Johns Bridge	Highway drainage

Many of the Non-Representative locations have multiple outfalls and the LWG only monitored one or two of the site outfalls. For these locations, the loads from the sampled outfall were extrapolated to the entire property. Therefore, runoff volumes were calculated for the entire property for each Heavy Industrial location as shown in the attached Figures B-3a to h. It should be noted that applying loads measured from one outfall at a site to an entire industrial site is a necessary simplifying assumption for calculating loads from Non-Representative Heavy Industrial sites. The assumption is that applying loads from one outfall to another outfall within the same industrial site will often be more accurate than using, for example, Representative Heavy Industrial loads. There may be particular sites where this is not the case, but it would be difficult to undertake a detailed analysis of each Non-Representative Heavy Industrial site to determine whether particular subareas of the each site are more similar to either the remainder of the site or other generalized heavy industrial areas within the harbor. Such a simplification is fundamentally no different than the extrapolation of measured Representative Heavy Industrial area loads to other heavy industrial areas where runoff chemical concentrations were never measured. In both cases, a range of actual activities exist in the measure and extrapolated areas that are never identical across the two areas.

There are two locations where there are two outfalls sampled at the same industrial site. The loading for these sites is discussed below:

- Schnitzer WR-123 and WR-384
  - The WR-123 outfall drains through the Schnitzer location but does not drain any part of the Schnitzer-owned land. Therefore, non-representative loading from the WR-123 outfall will apply only to the WR-123 basin.
  - The WR-384 basin is representative of the site activity of the Schnitzer property and will be applied to the entire property ownership.
- Gunderson WR-142/145 and Gunderson (former Schnitzer) WR-147
  - While these two outfalls are both located on property owned by Gunderson and drain runoff from Gunderson property, the WR-147 outfall represents runoff from an area that had different historical industrial activities and therefore the basins are split at the former property ownership boundary just upstream of WR-142/145 as shown in the attached Figure B-3g. The loads from the WR-147 outfall were extrapolated to include the former Schnitzer property and the loads from WR-142/145 outfall were extrapolated to include the remainder of the property..

5.2 CITY OF PORTLAND INDUSTRIAL OUTFALLS

Some City of Portland outfalls sampled by LWG, which drain a larger portion of industrial area rather than a specific industrial site, could be classified as non-representative. In this case, if a basin is deemed non-representative, the runoff volumes and subsequent loads were calculated separately for the particular basin. A list of these basins is shown below in Table B-3.

Table B-3. City of Portland Industrial Basins.

Location ID	Description
OF-22B	City - Doane Lk. Indus.
OF-M1, above Devine	City - Mocks Bottom
OF-M2	City - Mocks Bottom
OF-22	City – Willbridge Industrial
OF-16	City - Heavy Industrial

After the process of analyzing stormwater data was complete and the locations that are classified as Non-representative were determined, the runoff from each of these Non-representative locations was subtracted from the general land use runoff volumes. This could include any of the entire basins listed in Table B-3, if they were deemed Non-representative.

5.3 NON-REPRESENTATIVE HEAVY INDUSTRIAL LOCATIONS SAMPLED BY THE PORT OF PORTLAND

Six industrial locations sampled by the Port of Portland could also be deemed non-representative as part of the stormwater data analysis. These are listed below in Table B-4.

Table B-4. Port of Portland Industrial Basins.

Location ID	Description
OF-52C/Basin T	City - Terminal 4 Industrial
WR-183/Basin R	Terminal 4 - Slip 1
WR-181/Basin Q	Terminal 4 - Slip 1
WR-177/Basin M	Terminal 4 - Slip 1
WR-20/Basin L	Terminal 4 - Wheeler Bay
WR-169/Basin D	Terminal 4 (Toyota)

A February 26, 2007 memo from Ash Creek to the Port of Portland (Attachment C-1) discusses that many of the measured basins can be extrapolated to other Port of Portland basins. In the case that any of the above basins were deemed Non-representative, the loading from those basins were applied to the other nearby basins as detailed in the attached memo and briefly summarized below. Details on why this extrapolation is appropriate, if these locations are deemed Non-representative, are discussed in the memo, which is attached for reference. See Figure B-3j for a visual representation of this information. A map of the Port basins is included in Attachment B-1.

- OF-52C/Basin T and WR-177/Basin M – No extrapolation to other basins recommended.
- WR-183/Basin R – Was extrapolated to include Basin S and Basin N.
- WR-181/Basin Q – Was extrapolated to include Basin O and Basin S.
- WR-20/Basin L – Was extrapolated to include Basin J (PAHs only), Basin K, and Basin N.
- WR-169/Basin D – Was extrapolated to include Basin C.

5.4 GE DECOMMISSIONING FACILITY

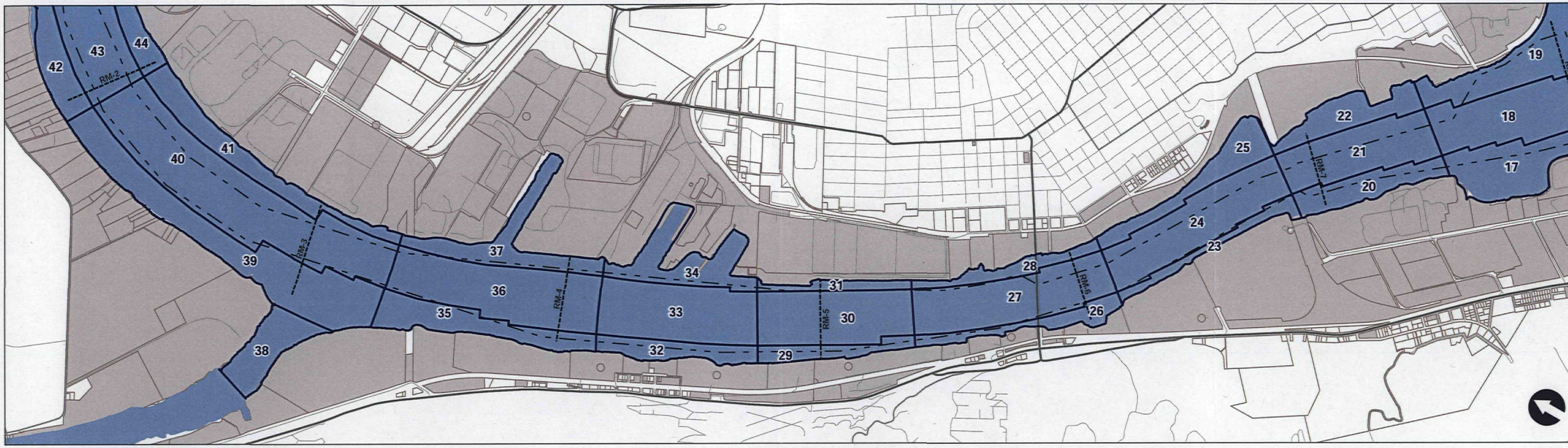
The GE Decommissioning Facility was originally included in the Stormwater Sampling FSP, but during the project initiation, the Stormwater Technical Team recommended and EPA agreed that it would be sampled by the site owner instead of LWG. If this site is deemed Non-representative, the sampled outfall will be extrapolated to the entire property as shown in Figure B-3i.

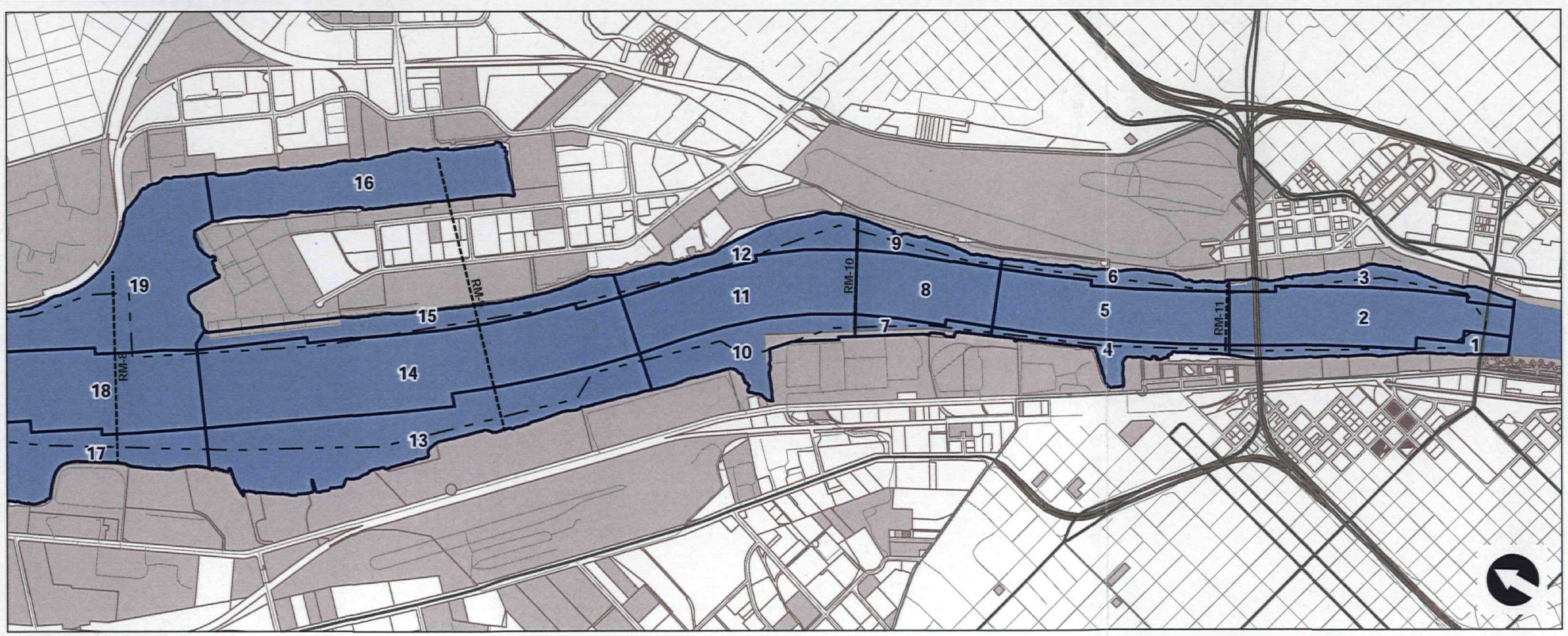
6.0 Weighting Factors For Each Sampling Location

As discussed in Section 5.1.2 and 6.2.2, a weighting factor based on the unit runoff volume divided by the sum of all unit volumes for all locations within a land use was used in order to calculate Site Weighted statistics. Unit runoff volumes for all sampling locations are included below in Table B – 5.

Table B-5. Unit Runoff Volumes.

Outfall	Label	Runoff (L)
WR-161	WR-161	82,057
WR-14	WR-14	130,859
WR-4	WR-4	197,229
WR-22	WR-22	2,861,463
WR-67	WR-67	511,731
WR-96	WR-96	166,606
WR-123	WR-123	6,045,395
WR-142	WR-142	52,366
WR-147	WR-147	235,332
WR-218	WR-218	3,218,984
WR-384	WR-384	811,968
WR-145	WR-145	71,162
WR-510	St. Johns Bridge - R	87,679
WR-107	WR-107	275,254
OF-16	OF-16	3,598,527
OF-53	OF-53	954,724
OF-52C	OF52C/Basin T	1,882,677
OF-49	OF-49	1,423,473
OF-18	OF-18	13,943,095
OF-18	Yeon Mixed Use	1,569,212
OF-19	OF-19	12,196,113
OF-22	OF-22	6,270,275
OF-22B	OF-22B	1,279,089
OF-22C	OF-22C	3,968,867
OF-M1	OF-M1	5,172,779
OF-M2	OF-M2	7,186,352
OF-15	HWY 30B	626,193
WR-169	WR-169/Basin D	1,220,964
WR-177	WR-177/Basin M	898,957
WR-181	WR-181/Basin Q	1,260,172
WR-183	WR-183/Basin R	506,912
WR-20	WR-20/Basin L	961,835
GE (OF-17)	GE Decommissioning	264,837
OF-18	HWY 30A	413,741



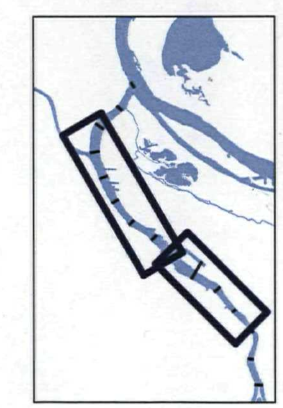


LEGEND

- AFT Model Cells
- River miles
- Navigation Channel
- Tax Lots
- Waterfront Ownership

Feet

0 1,000 2,000 3,000 4,000



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LWG LOWER WILLAMETTE GROUP

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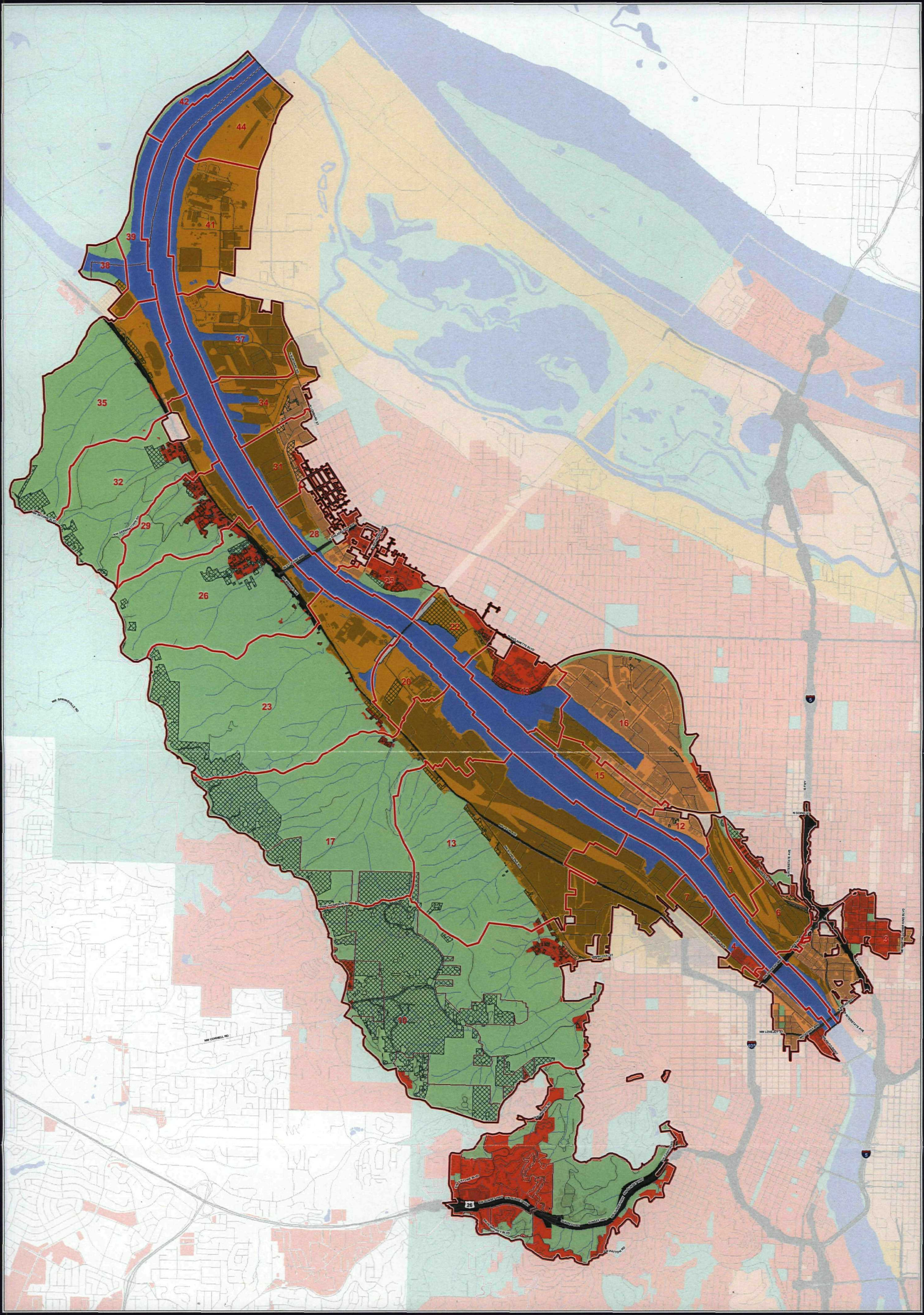
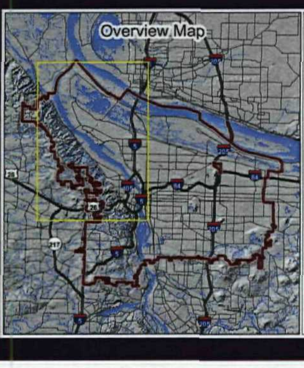
Figure B-1
Portland Harbor RI/FS
Stormwater Loading Calculation Methods
Hybrid Model Domain and Cells
River Mile 02 to 11





Legend

- City of Portland
- PH Hydroboundary
- Segment Basins
- Impervious Area
- Water Features
- Freeways
- Arterial Streets

PH Zoning Groups

- Heavy Industrial
- Light Industrial
- Parks and Open Spaces
- Residential/Commercial
- Major Transportation
- Open Space/Vacant Overlay

Lower Willamette Group - Analysis Layer Review Map

CITY OF PORTLAND ENVIRONMENTAL SERVICES
Systems Analysis
Spatial Analysis and Modeling

1 inch equals 2,000 feet

0 2,000 4,000 Feet

N W E S

Sheet No.	Date Printed:
Figure B-2	05/02/08

Produced by Systems Analysis: Map Request 4665 (KDR) May 2nd, 2008 \\Cassio\Modeling\Projects\14552001_PortHarbor\LWG\GIS\MXD\LWG_Review_2.mxd

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Figure B-3a
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-22

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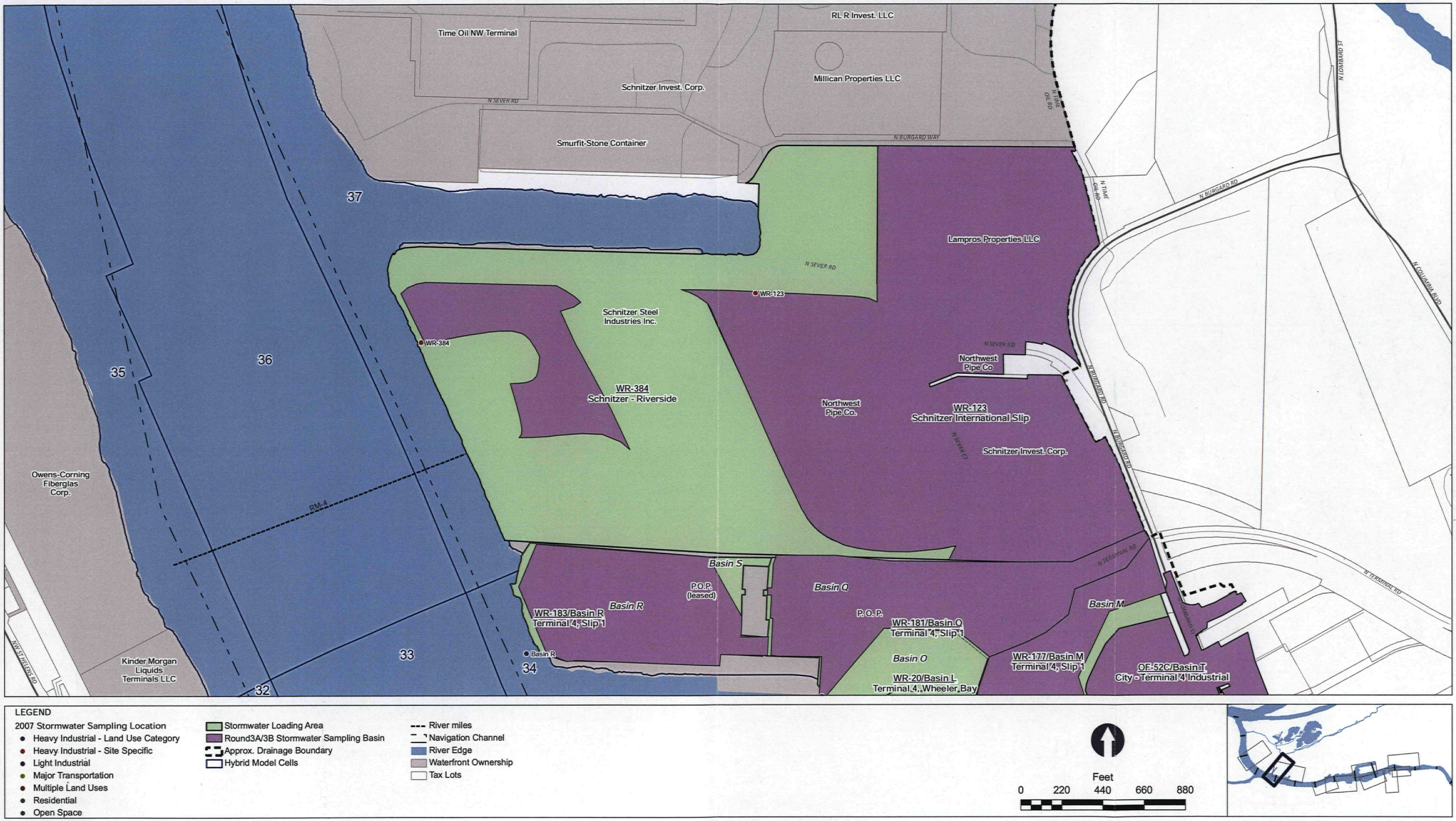

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Figure B-3b
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-123, WR-384

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LEGEND

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Stormwater Loading Area
- Round3A/3B Stormwater Sampling Basin
- Approx. Drainage Boundary
- Hybrid Model Cells

- River miles
- Navigation Channel
- River Edge
- Waterfront Ownership
- Tax Lots

Feet
0 175 350 525 700

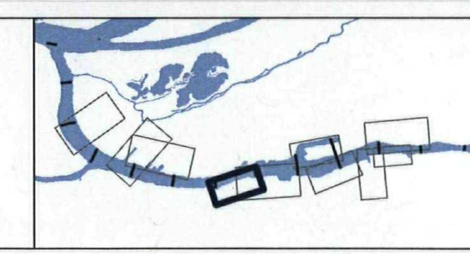

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Figure B-3c
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-107, WR-67

LEGEND

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Stormwater Loading Area
- Round3A/3B Stormwater Sampling Basin
- Approx. Drainage Boundary
- Hybrid Model Cells

- River miles
- Navigation Channel
- River Edge
- Waterfront Ownership
- Tax Lots

Feet

0 220 440 660 880

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Figure B-3d
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-14, WR-96

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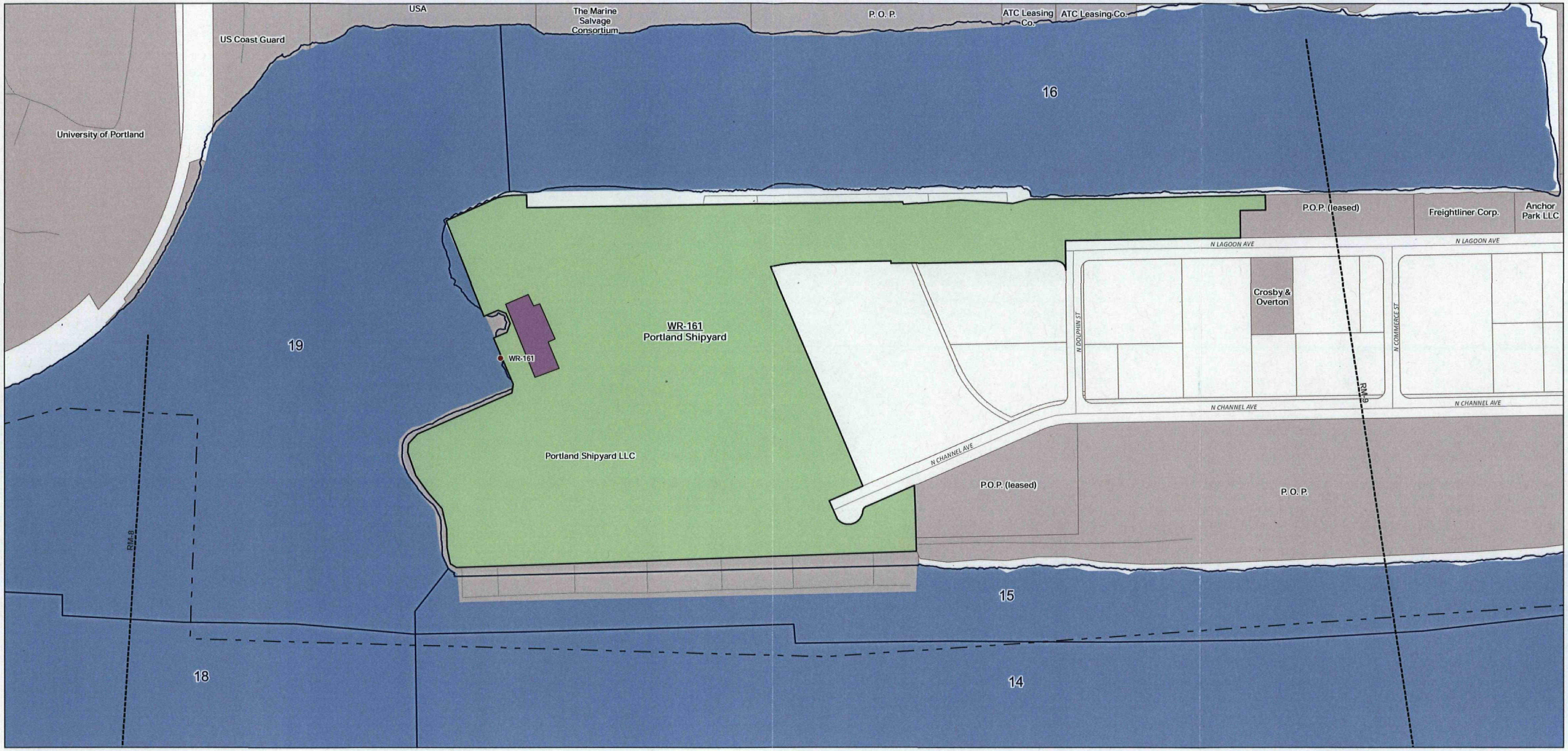

LEGEND

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Stormwater Loading Area
- Round3A/3B Stormwater Sampling Basin
- Approx. Drainage Boundary
- Hybrid Model Cells

- River miles
- Navigation Channel
- River Edge
- Waterfront Ownership
- Tax Lots

Feet

0 180 360 540 720

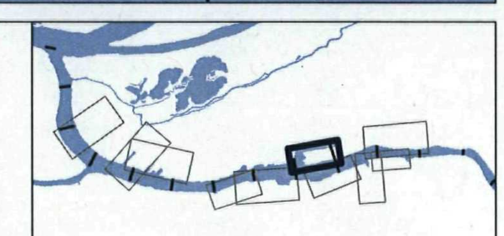

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Figure B-3e
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-161

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LEGEND

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Stormwater Loading Area
- Round3A/3B Stormwater Sampling Basin
- Approx. Drainage Boundary
- Hybrid Model Cells

- River miles
- Navigation Channel
- River Edge
- Waterfront Ownership
- Tax Lots

Feet
0 130 260 390 520

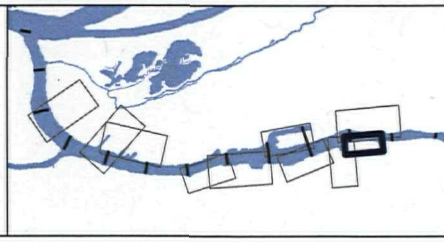

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Figure B-3f
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-4

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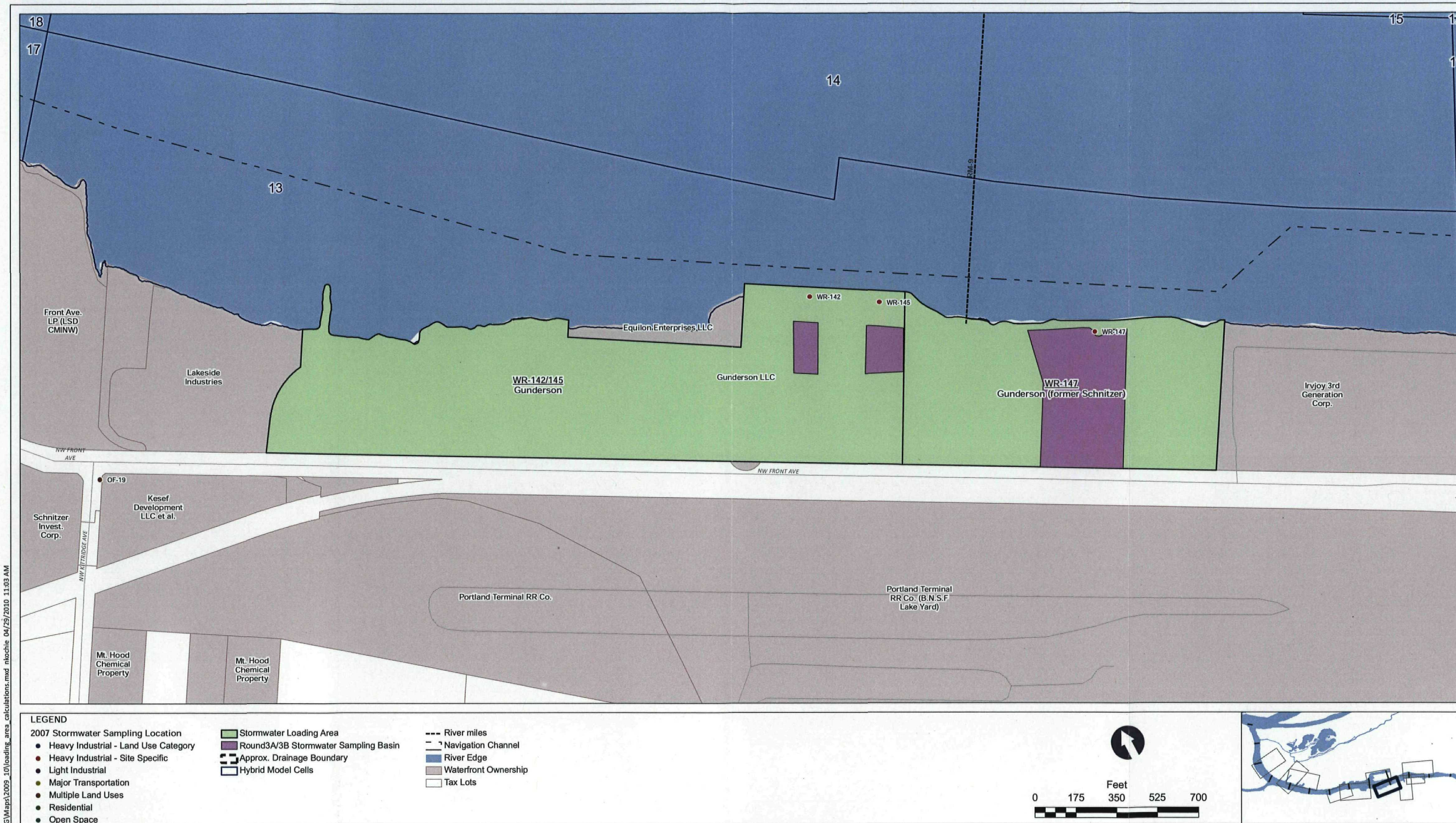

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Figure B-3g
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-142/145, WR-147

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LEGEND

2007 Stormwater Sampling Location
- Heavy Industrial - Land Use Category
- Heavy Industrial - Site Specific
- Light Industrial
- Major Transportation
- Multiple Land Uses
- Residential
- Open Space

- Stormwater Loading Area
- Round3A/3B Stormwater Sampling Basin
- Approx. Drainage Boundary
- Hybrid Model Cells

- River miles
- Navigation Channel
- River Edge
- Waterfront Ownership
- Tax Lots

Feet
0 220 440 660 880

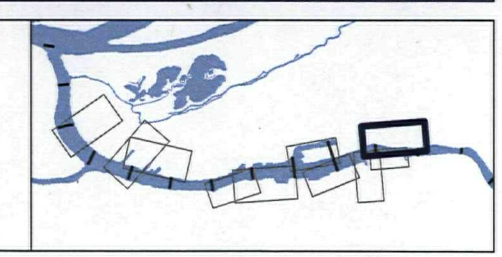

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Figure B-3h
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
WR-218

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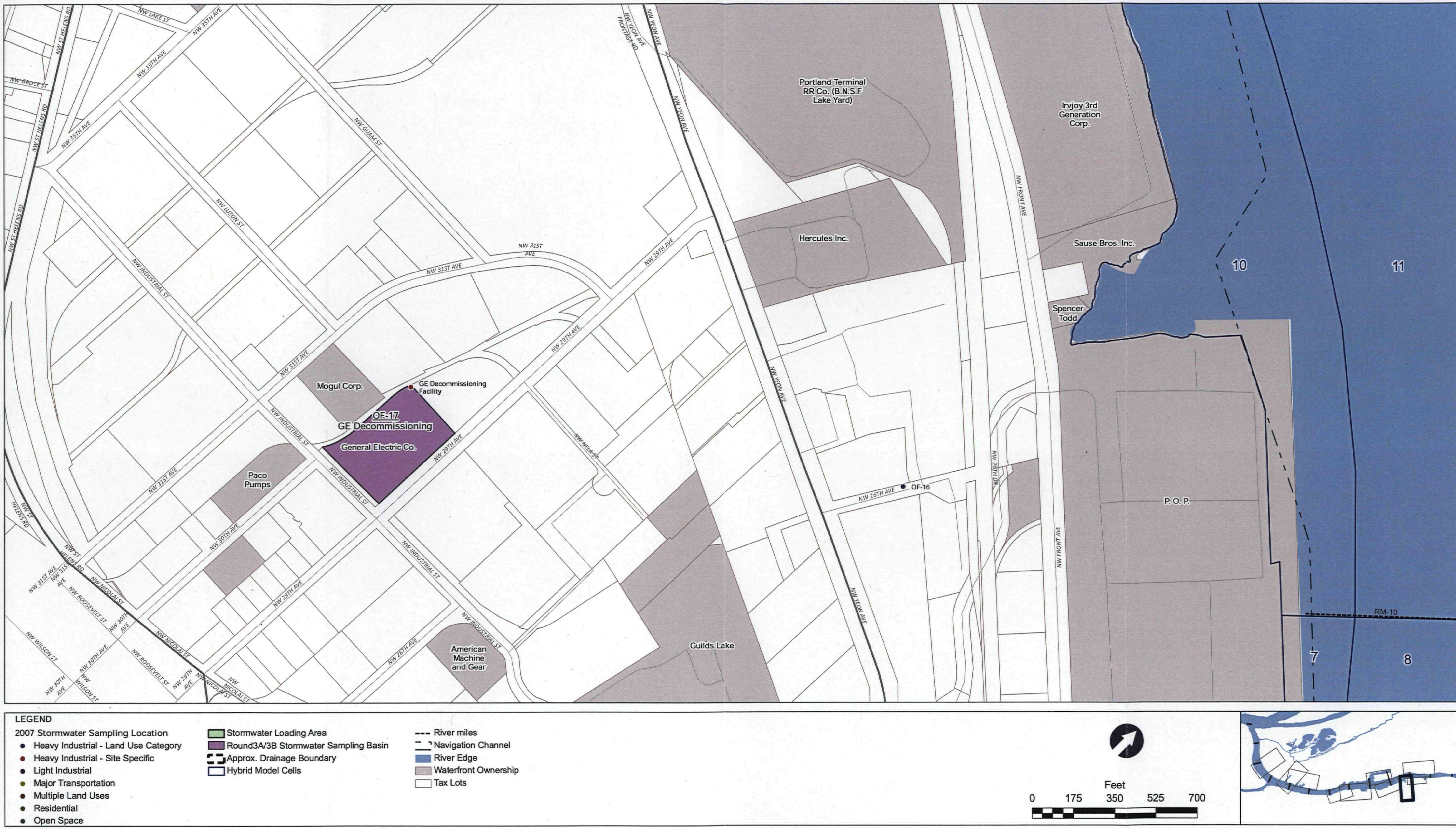

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Figure B-3i
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
OF-17

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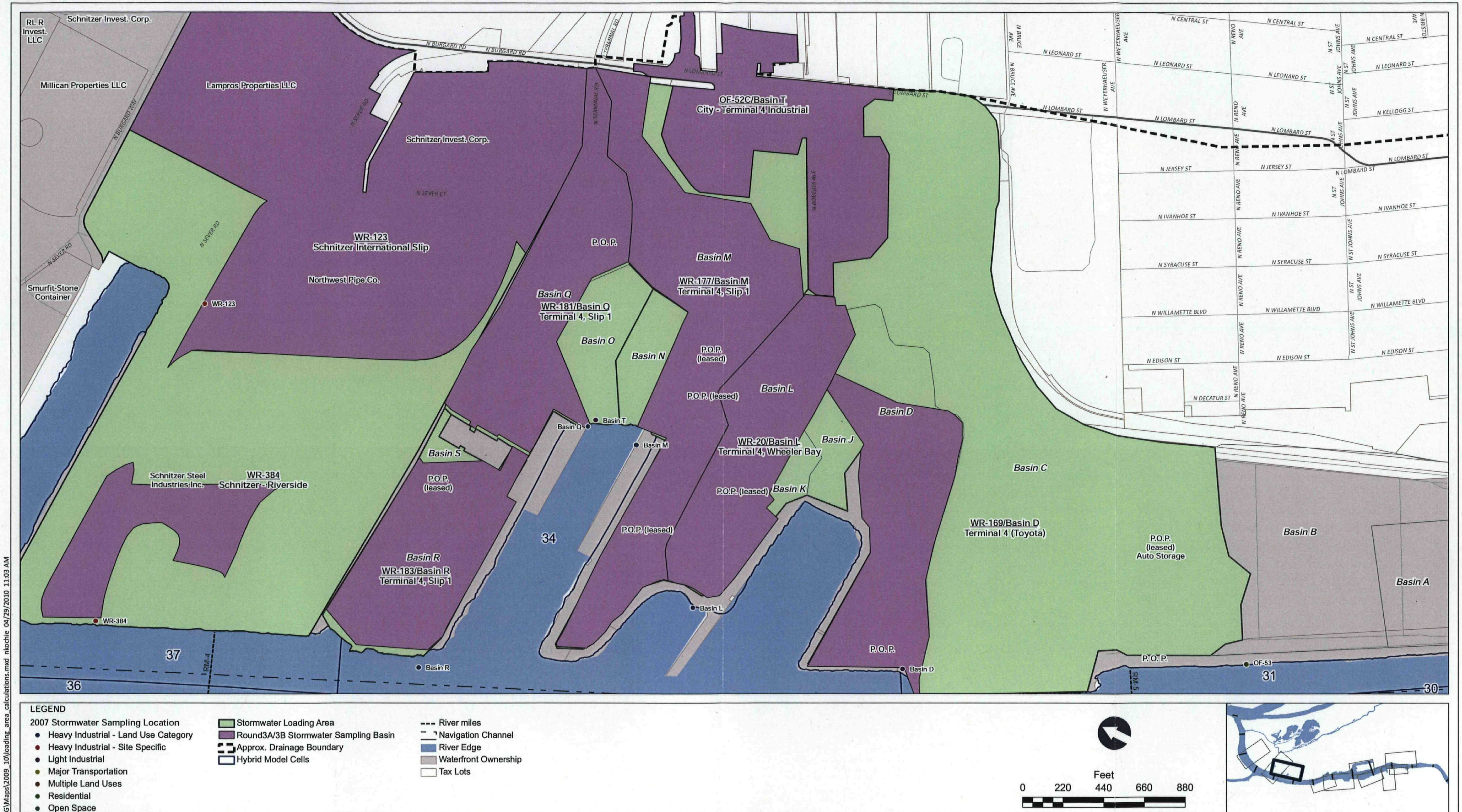

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Figure B-3j
Portland Harbor RI/FS
Stormwater and Sediment Trap Sampling Locations
Stormwater Loading Calculation Methods
Port of Portland Industrial Basins

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Attachment B-1

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Memorandum

Date: February 26, 2007

To: Krista Koehl, Port of Portland
Nicole Anderson, Port of Portland

From: Amanda Spencer, Ash Creek Associates

cc: Andy Koulermos, Newfields

Re: Rationale for Basin Selection for Storm Water Sampling and
Additional Information Requested by Oregon Department of Environmental Quality (DEQ)
Portland, Oregon
ACA No. 1267

This memorandum provides the rationale for selecting basins for storm water solids and whole water sampling and basins for data extrapolation to support the recontamination analysis at Terminal 4 and complete the storm water source evaluation for Terminal 4 Slips1 and 3 Upland Facilities (Upland Facilities; Figure 1). Additional information on surface soil data and the storm water conveyance system requested by the DEQ in a meeting with the Port of Portland on January 9, 2007 has also been included and is described below, following the discussion of the rationale for storm water sampling locations.

Rationale for Basins Proposed for Sampling

The rationale for basin selection consisted of an evaluation of data needs for completion of the recontamination analysis, as well as data needs to complete the storm water evaluation for Slips 1 and 3. Protocols selected for collecting the storm water data consist of conducting both sediment trap sampling for solids analysis and automatic composite storm water samplers for whole water analysis, where access allows. The following provides the rationale for each of these data needs for each basin proposed for sampling. Figures 2 through 8 provide supporting information (Figure 2 summarizes detected constituents in surface soil; and Figures 3 through 8 list the detected constituent concentrations for metals, total polycyclic aromatic hydrocarbons [PAHs], polychlorinated biphenyls [PCBs], pesticides, semivolatile organic compounds [SVOCs; except PAHs], and total petroleum hydrocarbons [TPH], respectively). Tables 1A through 1C list the PAH concentrations detected in surface soil at the Upland Facilities.

Basin D – Basin D was sampled using a sediment trap during the initial deployment. Sufficient sample was recovered to complete analyses for PCBs and pesticides. Basin D is one of the larger basins at Terminal 4 Slips 1 and 3 (17 acres, or 15 percent of the total drained area) and it currently has a unique usage for the Slip 1 and Slip 3

9615 Southwest Allen Boulevard, Suite 106
Portland, Oregon 97005-4814
(503) 924-4704 Portland
(360) 567-3977 Vancouver
(503) 924-4707 Fax
www.ashcreekassociates.com

Upland areas, being used primarily for automobile storage on a paved parking area. Historically, the area was used primarily for petroleum-related activities (e.g., the subsurface Union Pacific Railroad [UPRR] petroleum pipelines and Quaker State above-ground tanks for motor oil storage).

- Storm Water Evaluation Data Needs: Review of historical activities indicates the possibility of TPH or PAHs in surface soil (Hart Crowser, 2000). Remedial Investigation (RI) data did not indicate the presence of TPH in surface soils (releases appear to have been subsurface), but low concentrations of PAHs were detected (see Figures 2 and 3 and Table 1, attached). Phthalates have been identified by the DEQ as a potential storm water contaminant that could be present at all sites due to its ubiquitous nature. Therefore, to address storm water source evaluation data needs, additional storm water sampling and analysis for PAHs, TPH, and phthalates is proposed.
- Recontamination Analysis Data Needs: Sediment samples collected in 2006 demonstrated elevated levels of PAHs and low levels of lead and zinc downstream of Berth 414, which is currently being evaluated for an in-water cap. Therefore, to address potential recontamination analyses data needs, additional storm water data on metals and PAHs are proposed.

Basin D was selected for additional sampling because of its large size (relative to other basins at Slips 1 and 3), unique historical and current usages (relative to other basins in Slips 1 and 3), and the presence of chemicals of potential concern (COPCs) in sediments downstream of its outfall location. The manhole identified for deployment of the sediment trap sampler and installation of the composite storm water sampler is located downgradient of a Downstream Defender installed as a part of system upgrades during the development of this area for additional new Toyota automobile storage in 2004. The manhole was inspected on November 28, 2006, and sufficient access and space is available for the installation of both the sediment traps and a composite storm water sampler.

Basin L – This basin was sampled during the initial deployment for the recontamination analysis and sufficient solids were obtained for analysis for metals, PAHs, PCBs, pesticides, and total organic carbon (TOC). The conveyance system in this basin was recently reconfigured as a part of the railway expansion project at Terminal 4 Slip 1, reducing the drainage basin to 17.2 acres (from an original 30 acres). Basin L is still one of the larger drainage basins at Terminal 4 Slips 1 and 3, comprising 16 percent of the total drained area. Basin L is a sensitive basin for recontamination because it discharges into Wheeler Bay, an area that will be capped during the Terminal 4 Early Action.

- Storm Water Evaluation: Historical activities in basin L included warehousing, and the rail and ship import and export of materials, including soda ash and pencil pitch (Hart Crowser, 2005). Results of a site reconnaissance indicated the potential presence of pencil pitch fragments along the rail tracks. Results of surface soil sampling conducted in potential source areas (including along the rail lines) indicated the presence of detectable concentrations of PAHs, PCBs, metals, and pesticides (Figure 2).
- Recontamination Analysis: Basin L discharges to Wheeler Bay where sediment samples contained elevated concentrations of PAHs and lower levels of lead, zinc, dichloro-diphenyl-trichloroethane (DDT) and PCBs.

Basin L was selected for additional sampling due to its significant percentage of the overall drained area at Slips 1 and 3; the fact that it drains to Wheeler Bay, an area being capped during the Early Action; and the detected compounds in sediments in Wheeler Bay and in surface soil. Both the storm water and recontamination data needs include sampling and analysis for PAHs, PCBs, metals (including lead and zinc), and pesticides (primarily DDT compounds). Based on site reconnaissance conducted on October 18, 2006, adequate access is available for both in-line sediment trap sampling and an automatic composite sampler, and both are proposed for this basin.

Basin M – This basin was not initially selected for sampling during the 2004/2005 deployment because a large portion of the basin is unpaved and the surface water infiltrates. However, the conveyance system in this basin was reconfigured as a part of the recent railway expansion, and a treatment unit was installed at the downstream end. This reconfiguring included enlarging the drainage area by acquisition of a portion of the adjacent basin L, increasing the basin size to 29.1 acres. Basin M is now the largest basin at Terminal 4 Slips 1 and 3, comprising 26 percent of the drained area. The drainage from this basin currently discharges to Slip 1, but will be reconfigured as part of the Early Action confined disposal facility (CDF). Therefore, an understanding of the storm water load in this conveyance system is needed.

- Storm Water Evaluation: Historical activities in basin M included vehicle parking, equipment storage, and rail import and export of materials, including soda ash and pencil pitch (HartCrowser, 2004). Results of a site reconnaissance indicated the potential presence of pencil pitch fragments along the rail tracks. Results of surface soil sampling conducted in potential source areas (including along the rail lines) indicated the presence of detectable concentrations of PAHs, PCBs, metals (arsenic, cadmium, copper, nickel, lead, mercury, and zinc), and pesticides (Figure 2).
- Recontamination Analysis: Basin M discharges to Slip 1, where sediment samples contained elevated concentrations of PAHs and metals (primarily cadmium, copper, nickel, lead, and zinc), and detections of PCBs and DDT compounds. A treatment system has been installed in the conveyance line for the reconfigured basin M that treats the storm water flow for soluble metals and oil and grease.

Basin M was selected for additional sampling due to its significant percentage of the overall drained area at Slips 1 and 3; its recent reconfiguration to drain a larger area of Slip 1; and its sensitivity for the Early Action recontamination analysis due to the future plan to drain this basin to the river just upstream of the CDF and an area designated by the Early Action for monitored natural recovery (MNR). Both the storm water and recontamination data needs include sampling and analysis for PAHs, PCBs, metals (including lead and zinc), and pesticides (primarily DDT compounds). Based on the October 18, 2006 site reconnaissance, a manhole is present directly downgradient of the treatment unit. Adequate access is available within the manhole for both in-line sediment trap sampling and an automatic composite sampler, and both are proposed for this basin.

Basin Q – This basin was sampled using an in-line sediment trap during the previous storm water sampling deployment. In addition, a grab bulk storm water sample was collected for total suspended solids (TSS) analysis. However, the manhole accessed for the sediment trap installation is upstream of more than 50 percent of the catch basins on this conveyance line. Basin Q is approximately 18 acres, comprising 16 percent of the drained area of Terminal 4 Slips 1 and 3. The outfall for this basin currently is located at the head of Slip 1; however, the conveyance line will be reconfigured to discharge to the river as part of construction of the Early Action CDF.

- Storm Water Evaluation: Historical activities in basin Q consisted of grain storage and associated rail and ground support activities (HartCrowser, 2004). A number of potential source areas were identified and sampled during the RI process. Results of surface soil sampling conducted in potential source areas indicated the presence of detectable concentrations of PAHs, PCBs, pesticides, and metals (chromium, lead, mercury, and zinc; Figure 2).

- Recontamination Analysis: Basin Q discharges to Slip 1 where sediment samples contained elevated concentrations of PAHs and metals (primarily cadmium, copper, nickel, lead, and zinc), and detections of PCBs and DDT compounds.

Basin Q was selected for additional storm water sampling due to its relative size (16 percent of the total drained area of Slips 1 and 3); its unique usage (grain storage with associated support activities); the similarity between detected compounds in surface soil and sediments; and the sensitivity of recontamination because the reconfigured system will drain to Berth 401, an area designated for monitored natural recovery and a small in-water cap as part of the Early Action.

This basin was inspected during the October 18, 2006 reconnaissance to determine if a manhole was present further down the line from the original sediment trap sampling location; and it was confirmed that there is not a manhole further down the conveyance line. However, it is possible to drill down to the line for the installation of a composite storm water sampler and this can be completed in a location downstream of most of the catch basins on the line. Therefore, storm water sampling will be conducted at basin Q via an automatic composite sampler. Further sediment trap sampling is not proposed at this basin because: (1) the sediment trap sampler deployed during the initial deployment period captured sufficient volume to allow for the analysis of the complete set of contaminants of interest (COIs) for this basin (PAHs, metals, PCBs, phthalates, pesticides); (2) if the outfall is submerged (as is the case for this basin), a manhole is needed for the deployment of a sediment trap sampler and a manhole further downstream of the initial sample location is not present; and (3) the collection and analysis of the composite storm water samples will allow sufficient data to assess the contribution from the parts of the system not sampled by the sediment trap to complete the evaluation of mass loading and assess storm water as a potential upland source to the river.

Basin R – Basin R was not sampled during the initial deployment. The basin is approximately 15 acres, comprising 14 percent of the drained area of Slips 1 and 3. This basin discharges upstream of the Berth 401 monitored natural recovery and in-water cap area discussed above.

- Storm Water Evaluation: Historical activities in basin R consisted of ancillary activities to support grain import, export, and storage (HartCrowser, 2004). A number of potential source areas were identified and sampled during the RI process. Results of surface soil sampling conducted in potential source areas indicated the presence of elevated PAHs near the rail lines (which is also near the catch basins for the conveyance line) and detectable concentrations of PAHs, PCBs, pesticides, and metals in other areas of the basin (Figure 2).
- Recontamination Analysis: Basin R discharges upstream of Berth 401 where sediment samples contained PAHs and metals (primarily copper, nickel, and zinc), PCBs, and DDT compounds. An elevated PCB level was also detected in sediment adjacent to this basin.

Basin R was selected for sampling primarily due to the elevated PAHs in surface soil near the conveyance line and additionally because the basin discharges directly upstream of Berth 401 where the Early Action calls for a small sediment cap and monitored natural recovery. The conveyance line was inspected on October 18, 2006, and it was determined that adequate access for both in-line sediment trap sampling and an automatic composite sampler is available. Both sampling methods will be conducted.

Basin T (City of Portland Outfall 52C) – This outfall drains to Slip 1 and additional data is needed to support the recontamination analysis. The farthest downstream manhole was inspected on October 18, 2006, and it was determined that there is adequate access for both an in-line sediment trap sampler and an automatic composite sampler. Both are proposed for this basin to provide a comparison of data with the initial deployment and to assess the additional information provided by the bulk stormwater sampling. An access agreement between the Port and the City has been completed to allow this work to proceed.

City of Portland Outfall 53 – Data is needed from this conveyance line to complete the recontamination analysis as it discharges directly upstream of the Early Action area. An in-water sediment trap sampler was placed near this outfall in the 2004/2005 deployment period. However, the sampler deployed near this outfall was tipped over and no sample was obtained. Therefore, sediment trap and automatic composite storm water samplers will be deployed within the conveyance line to evaluate its contribution to the system. An access agreement between the Port and the City has been completed to allow this work to proceed.

Basins Proposed for Data Extrapolation

As a part of the scoping of the storm water sampling program to meet the source evaluation and recontamination needs, data available for all of the basins were reviewed. Some of the basins were selected (as described above) and some of the basins were determined not appropriate or not necessary for sampling to complete the objectives of the storm water source control evaluation and recontamination analysis. The rationale for the basins selected for data extrapolation is provided below.

Basin C – Sampling of basin C was evaluated to determine data needs for completing the recontamination analysis.

- Recontamination Analysis: Basin C was sampled for solids as part of the 2004/2005 deployment, and the collected solid samples were analyzed for PAHs, metals, phthalates, PCBs, and pesticides (Blasland, Bouck & Lee [BBL], 2005c). Bulk storm water sampling for TSS data was not completed during the 2004/2005 sampling program. As detailed above, storm water and solids from basin D are being sampled. Because the land use and storm water management systems of basins C and D are almost identical, the additional information obtained from basin D during the 2006/2007 deployment can be readily extrapolated to basin C to complete the recontamination analysis of potential upstream contributions from basin C to the Early Action area.

Basin J – Basin J is approximately 2.6 acres, comprising just 2 percent of the total drained area of Slips 1 and 3. The basin outfall drains to the head of Slip 3. Basin J consists of the Gearlocker building and a surrounding unpaved, graveled yard area. With the exception of one catch basin, the drainage to this basin is primarily from roof drains of the Gearlocker building and most of the surface water in this basin infiltrates.

- Storm Water Evaluation and Recontamination Analysis: Historically, land use in basin J consisted of the Quaker State facility. Results of the Terminal 4 Slip 3 RI found a limited area of PAH concentrations (primarily benzo-a-pyrene) that exceeded risk-based human health screening levels for occupational use. The PAHs appear to be limited to the former Quaker State Tank Farm area and the source of the PAHs appears to be associated with the former activities in the Quaker State area (Ash Creek, 2004). Given the presence of pencil pitch observed along the tracks in basins M and L, there is a higher likelihood of PAHs in storm water from these areas than in basin J. Furthermore, site reconnaissance indicates that the area containing the one catch basin not related to the roof drains does not drain the former Quaker State Tank

Farm area. Finally, the area drained by the one catch basin is extremely limited and represents only a small fraction of the overall area drained at Slips 1 and 3.

Basin J was not selected for sampling due to its small size, limited drained area, and the construction of the basin such that surface water predominantly infiltrates into the subsurface through the basin's graveled surface. PAHs are the only constituent of potential concern in basin J, and the PAH results from basin L can conservatively be extrapolated to basin J for the source control and mass loading evaluations.

Basin K – Basin K is approximately 1.5 acres, comprising just 1 percent of the total drained area of Slips 1 and 3. The basin consists of two catch basins and an outfall draining to the head of Slip 3. Based on land use, the basin can be considered a sub-area of basin L, being comprised of identical usage (part trackage and part Kinder Morgan operational facility).

- Storm Water Evaluation and Recontamination Analysis: As identified above, historical and current land use in basin K is identical to basin L. Given the same usage, the surface soil is expected to contain the same COPCs as identified in basin L (PAHs, PCBs, pesticides, and metals), and at the same levels.

Basin K was not selected for sampling due to its small size, limited drained area, and identical current and historical land use with basin L. Results from basin L can be extrapolated to basin K for both the source control and mass loading evaluations.

Basin N – Basin N is approximately 3.5 acres, comprising just 3 percent of the total drained area of Slips 1 and 3. The basin currently drains to the head of Slip 1 but will be reconfigured to discharge to the river as part of construction of the CDF. Basin N was originally selected for sampling for the 2005 deployment (BBL, 2005b); however, a field reconnaissance by BBL on January 12, 2005, determined that land use was similar to larger basins that drain to the same sub-area, and the basin was not sampled during the 2005 deployment.

- Storm Water Evaluation: This basin drains a graveled area to the west of the Rogers Terminal and Shipping facility. International Raw Materials (IRM) is south of basin N and little runoff from IRM appears able to drain to this basin. Only a small portion of a graveled roadway used by IRM appears to have the potential to drain to one catch basin of basin N. The IRM facility is primarily unpaved and surface water at IRM appears to infiltrate. Potential source areas in basin N were identified and sampled as a part of the RI. Results of surface soil analysis indicated detections of PAHs and metals. Elevated concentrations of lead were detected in one localized area during the RI and this basin was reconsidered for sampling based on the lead results. However, site reconnaissance on October 18, 2006, demonstrated that storm water from the surface soil area containing lead would not flow to the basin N catch basin/conveyance system. The detected concentrations of PAHs and metals outside of the localized lead area are similar to or lower than those found in other basins being sampled (e.g., basins R, Q, M, and L; see Figures 3 and 4 and Table 1, attached). Current use of basin N is limited primarily to surface vehicle traffic and rail spurs, similar to current uses in basins O, L, and R.
- Recontamination Analysis: As identified above, the current use of basin N is limited to primarily surface vehicle traffic and rail spurs, similar to current uses in basins O, L, and R.

Due to the small basin size and similar uses to other basins, sampling at this basin is not proposed. Data collected at basins L and R in the upcoming deployment, and from O during the initial deployment, can be used to evaluate the potential adverse effects of storm water sources in basin N. This will provide a conservative assessment of storm water source and recontamination potential, because the land use within basin N, while similar, is more limited than the above basins. Additionally, the COPC concentrations in surface soil in potential source areas identified during the RI are similar to or lower than concentrations in the other basins (see Figures 3 through 7, attached).

Basin O – Basin O is approximately 5.5 acres, comprising just 5 percent of the drained area of Slips 1 and 3. This basin was sampled during the initial deployment and the samples were analyzed for the presence of metals due to the presence of a temporary soil stockpile in the area.

- Storm Water Evaluation: Historical land uses in basin O were limited, and only two potential source areas were identified during the RI proposal process that required further assessment. These uses (ancillary areas to the grain storage silos and the possible presence of a disposal area of creosoted wood) were the same as identified in basin Q. Surface soil sample results indicated the presence of low concentrations of metals, PAHs, and pesticides in the waste-wood area, and low concentrations of PCBs in the grain storage area. These detections were similar in magnitude and composition to surface soil sampling results from similar source areas identified in basin Q (see Figures 3 through 7). No other source areas that could have impacted surface soil were identified in the DEQ-approved RI Work Plan.
- Recontamination Analysis: Plans to remove the temporary stockpile are underway at the Port. Uses of basin O are limited to some vehicular traffic for trucks or cars traveling to and from basins L and M and the UPRR railroad tracks on the north side of the basin.

This basin was not selected for additional sampling due to its small size, limited current and historical land use, lack of surface sources, and similarity in surface soil sampling results to basin Q. Results from basin Q can be extrapolated to basin O to assess for potential storm water source issues and recontamination analysis.

Basin S – Basin S is approximately 1 acre and comprises less than 1 percent of the drained area of Slips 1 and 3. This basin was not selected for sampling in the 2005 deployment due to its small size.

- Storm Water and Recontamination Analysis Evaluation: Historical land use in basins R, S, and Q comprised the former grain import, export, and storage operation at Slip 1. The area is primarily vacant at this time. No potential surface soil sources were identified in the basin S area in the DEQ-approved RI work plan for Terminal 4 Slip 1 Upland Facility, and no surface soil sampling was conducted in this area. The basin is predominantly paved.

Due to its small size, lack of surface sources, and similar land use to basins Q and R, basin S was not selected for sampling. Storm water sampling results from basins Q and R can be extrapolated to basin S to conservatively assess potential source control and recontamination analysis elements.

Finally, to assist in both the recontamination evaluation and the storm water characterization program, Ash Creek plans to walk the Terminal 4 Upland Facility during a significant rain event (e.g., an event with more than 1/2 inch of rain in a 24-hour period, if possible,) to physically observe and document areas of overland flow and infiltration. Specifically, areas adjacent to river and slip banks will be evaluated to assess the potential for overland flow to the banks from the facility. Similarly, catch basins within each drainage basin will be observed to better estimate the aerial extent of drained area and document areas of infiltration.

Additionally Requested Information

The DEQ has requested information to assist in its evaluation of storm water in accordance with the Joint Source Control Strategy (JSCS) guidance document (DEQ, 2006). Specifically, the DEQ requested:

1. A site plan showing paved and unpaved areas in relation to the storm water conveyance system (including catch basins) and surface soil sampling locations. Figure 9, attached, shows each of these elements.

2. Screening of analytical results for surface soil samples collected within 100 feet of existing catch basins against DEQ JSCS toxicity and bioaccumulative sediment screening levels. Figure 10 provides a summary of this information and identifies surface soil sampling locations within 100 feet that have concentrations of COI that exceed either the JSCS toxicity or bioaccumulative screening level values for sediment. Figure 11 shows the locations of surface soil samples where detected COI concentrations exceed JSCS sediment screening levels, regardless of location relative to a catch basin.

In addition, Figures 3 through 8 summarize COI detected in surface soil samples collected during the RI programs for the Upland Facilities: Figure 3 presents metals concentrations detected in surface soil above regional background concentrations[1]; Figure 4 presents the total PAH concentrations detected in surface soil samples; and Figures 5 through 8 summarize the detected concentrations of PCBs, pesticides, semi-volatile organic compounds (other than PAHs), and TPH, respectively. On each of the figures, a table is included that lists the JSCS sediment screening levels for the detected constituents for comparison. Finally, Tables 1A through 1C provide the detected PAH concentrations in surface soils from the Upland Facilities and include a screen against PECs as represented on Table 3-1 of JSCS sediment screening levels (bioaccumulative sediment screening level values are not provided on the JSCS document ,Table 3-1 for PAHs).

ATTACHMENTS:

Table 1A – PAHs in Surface Soil
Table 1B – PAHs and TPH in Surface Soil Samples
Table 1C – PAH Concentrations in Surface Soil
Figure 1 – Facility Location Map
Figure 2 – Constituents Detected in Surface Soil
Figure 3 – Metals Concentrations Detected Above Regional Background in Surface Soil
Figure 4 – Total Polynuclear Aromatic Hydrocarbons Detected in Surface Soil
Figure 5 – Polychlorinated Biphenyl Concentrations Detected in Surface Soil
Figure 6 – Pesticide Concentrations Detected in Surface Soil
Figure 7 – Semi-Volatile Organic Compounds Detected in Surface Soil (Except Polynuclear Aromatic Hydrocarbons)
Figure 8 – Total Petroleum Hydrocarbon Concentrations Detected in Surface Soil
Figure 9 – Location of Surface Soil Sampling Points, Drainage Basins, and Conveyance Lines
Figure 10 – Exceedances of JSCS Sediment Screening Levels in Surface Soil Within 100 feet of Catch Basins
Figure 11 – Surface Soil Results Compared to JSCS Sediment Screening Levels

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[1] Rrepresented by the Washington Department of Ecology publication Natural Background Soil Metal Concentrations in Washington State dated October 1994.

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID	T4S1S-11	T4S1S-12	T4S1S-13	T4S1S-15-0.5	T4S1S-16-0.5	T4S1S-17-0.5	T4S1S-18-0.5	T4S1S-19-0.5	T4S1S-5	T4S1S-6	T4S1S-7
	Drainage Basin	R	R	R	R	R	R	R	R	R	R	R
	Lab ID	K2502049-008	K2502049-009	K2502049-010	K2502049-010	K2502049-010	K2502049-010	K2502049-010	K2502049-010			
	Sample Interval	0 - 0.5	0 - 0.5	0 - 0.5	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0.5 - 1	0 - 0.5	0 - 0.5	0 - 0.5
	Sample Date	3/22/2005	3/22/2005	3/22/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	9/6/2005	3/22/2005	3/22/2005	3/22/2005
	OU	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1
Compound (Concentrations in µg/kg)	McDonalds PECs											
Naphthalene	561	7.9	76	28	17.5 U, D	140 U	71.8 U	14.2 U	70.8 U	330 U, J	330 U, J	91 J
2-Methylnaphthalene	200	5.3	42	16	--	--	--	--	--	330 U, J	330 U, J	65 J
Acenaphthylene	200	11	29	31	29 J, D	140 U	56.8 J, D	14.2 U	37.4 J, D	330 U, J	330 U, J	97 J
Acenaphthene	300	14	**340**	200	37.1 J, D	53.5 J, D	37.8 J, D	7.32 J, D	17.6 J, D	340 U, J	340 U, J	**350** J
Fluorene	536	6.4	110	65	22.6 J, D	140 U	21.5 J, D	14.2 U	70.8 U	340 U, J	340 U, J	180 J
Dibenzofuran	--	4.4 J	62	36	--	--	--	--	--	340 U, J	340 U, J	100 J
Phenanthrene	1170	90	**2000** D	**1300** D	258 D	313 D	203 D	37.6 D	136 D	47 J	100 J	**1700** J
Anthracene	845	31	350	220	78 D	66.1 J, D	115 D	8.62 J, D	50.2 J, D	30 J	24 J	390 J
Fluoranthene	2230	290	**6400** D	**3900** D	667 D	853 D	490 D	88.8 D	359 D	26 J	110 J	**3100**
Pyrene	1520	290	**5800** D	**3800** D	734 D	900 D	552 D	99.2 D	456 D	77 J	170 J	**2700**
Benzo(b)fluoranthene	--	310	6200 D	3900 D	616 D	1080 D	631 D	79.5 D	342 D	92 J	210 J	3800
Benzo(k)fluoranthene	13000	300	4200 D	3300 D	627 D	695 D	604 D	85.1 D	378 D	31 J	85 J	1100 J
Benzo(a)anthracene	1050	190	**3900** D	**2400** D	446 D	581 D	358 D	57.3 D	249 D	52 J	100 J	**2200**
Chrysene	1290	250	**4900** D	**3200** D	585 D	789 D	467 D	72 D	335 D	69 J	140 J	**2500**
Benzo(a)pyrene	1450	310	**6000** D	**3800** D	616 D	830 D	571 D	83.8 D	354 D	69 J	150 J	**2800**
Indeno(1,2,3-cd)pyrene	100	**390**	**5400** D	**3700** D	**344** D	**403** D	**290** D	41.3 D	**185** D	64 J	**130** J	**2500**
Dibenz(a,h)anthracene	1300	77	1100	780	117 D	142 D	99.4 D	14.5 D	61.6 J, D	330 U	35 J	660
Benzo(g,h,i)perylene	300	**380**	**5000** D	**3400** D	**372** D	**416** D	**294** D	44.6 D	206 D	93 J	140 J	**2600**

Notes:
1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method

detection limit (MDL).
6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID	T4S1SB-14-1-1	T4S1SB-15-1-1	T4S1SB-16-1-1	T4S1SB-17-1-1	T4S1SB-18-1-1	T4S1SB-31-0-1	T4S1SB-32-0-1	T4S1SB-33-0-1	T4S1SB-42-1-1	T4S1SB-45-1-1	T4S1SB-46-1-1
	Drainage Basin	R	R	R	R	R	Q	Q	Q	R	R	R
	Lab ID	K2406368-002	K2406804-009	K2406804-007	K2406848-001	K2406699-005	K2406848-007	K2406767-009	K2406804-001	K2406804-003	K2406321-001	K2406321-002
	Sample Interval	1 - 2	1 - 2	0.5 - 1.5	1 - 2	1 - 1.5	0.5 - 1.5	0.5 - 1.5	0.25 - 1	0.5 - 1.5	0.5 - 2	0.5 - 2
	Sample Date	8/24/2004	9/3/2004	9/3/2004	9/7/2004	9/2/2004	9/3/2004	9/3/2004	9/3/2004	9/3/2004	8/23/2004	8/23/2004
	OU	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1
Compound (Concentrations in µg/kg)	McDonalds PECs											
Naphthalene	561	10	2.8 J	2.4 J	2.1 J	20	33	1.3 J	9.9	2.6 J	36	1.2 J
2-Methylnaphthalene	200	6.8	1.4 J	1.5 J	1.4 J	18	50	0.66 J	15	1.4 J	37	0.76 J
Acenaphthylene	200	50	3.5 J	3.2 J	3.8 J	13	14	5 U	7.7	13	27	0.59 J
Acenaphthene	300	11	0.56 J	0.72 J	1.1 J	1.9 J	1.7 J	5 U	0.78 J	1.2 J	1.8 J	4.9 U
Fluorene	536	8.2	0.51 J	0.63 J	1.5 J	1.8 J	2.7 J	5 U	1.4 J	0.66 J	4.2 J	4.9 U
Dibenzofuran	--	7.5	0.54 J	0.75 J	0.37 J	5.5	21	5 U	4 J	0.94 J	9.8	4.9 U
Phenanthrene	1170	260	7.9	7.3	30	51	66	0.66 J	46	17	110	1.2 J
Anthracene	845	68	4.4 J	5	9.3	19	20	5 U	9.4	12	32	0.78 J
Fluoranthene	2230	520	18	15	39	120	73	1.3 J	48	62	280	3.4 J
Pyrene	1520	560	25	20	60	130	110	1.5 J	72	82	360	4.8 J
Benzo(b)fluoranthene	--	320	15	16	14	78	140	1 J	61	58	230	2.1 J
Benzo(k)fluoranthene	13000	260	13	12	15	91	67	0.66 J	49	45	170	1.7 J
Benzo(a)anthracene	1050	210	11	9	24	59	66	0.98 J	38	58	150	2.1 J
Chrysene	1290	340	17	15	27	96	150	0.91 J	63	69	230	2.2 J
Benzo(a)pyrene	1450	320	8.9	12	15	84	97	0.65 J	58	53	250	1.8 J
Indeno(1,2,3-cd)pyrene	100	**330**	15	15	12	82	84	0.92 J	61	39	**280**	3 J
Dibenz(a,h)anthracene	1300	53	2.6 J	2.7 J	2.6 J	12	24	5 U	13	9.6	39	0.54 J
Benzo(g,h,i)perylene	300	**320**	17	16	12	100	110	0.87 J	67	40	290	3.1 J

Notes:
1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method

detection limit (MDL).
6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID	T4S1SB-47-1-1	T4S1SB-48-1-1	T4S1SB-49-1-1	T4S1SB-50-1-1	T4S1SB-82-1-1	T4S1SB-83-1-1	T4S1SB-89-0-1	T4S1SB-90-0-2	T4S1SB-9-0-1	T4S1SB-92-0-1	T4S1SB-93-0-1
	Drainage Basin	R	R	R	R	R	R	Q	Q	R	O	O
	Lab ID	K2406321-004	K2406321-005	K2406321-006	K2406368-001	K2406644-003	K2406644-001			K2406699-003		
	Sample Interval	0.5 - 2	0.5 - 2	0.5 - 2	0.5 - 2.5	0.5 - 1.5	1 - 2	0.5 - 2.5	1 - 3	0 - 1	1 - 3	0.5 - 2.5
	Sample Date	8/23/2004	8/23/2004	8/23/2004	8/23/2004	9/1/2004	9/1/2004	9/7/2005	9/7/2005	9/2/2004	9/7/2005	9/7/2005
	OU	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1	OU1
Compound (Concentrations in µg/kg)	McDonalds PECs											
Naphthalene	561	1.4 J	1.4 J	1.4 J	1.1 J	2.7 J	1.9 J	15.2 U	14.3 U	3.1 J	3.49 J, D	7.47 U, D
2-Methylnaphthalene	200	0.91 J	0.92 J	0.84 J	0.64 J	1.6 J	0.78 J	--	--	1.5 J	--	--
Acenaphthylene	200	0.27 J	0.52 J	5 U	0.46 J	2.3 J	0.47 J	15.2 U	14.3 U	1.7 J	5.88 J, D	7.47 U, D
Acenaphthene	300	4.9 U	4.9 U	5 U	5 U	2.2 J	4.9 U	15.2 U	14.3 U	0.33 J	20.2 D	7.47 U, D
Fluorene	536	4.9 U	4.9 U	5 U	5 U	1.4 J	0.36 J	15.2 U	14.3 U	0.57 J	8.27 J, D	7.47 U, D
Dibenzofuran	--	4.9 U			5 U	0.74 J	0.23 J	--	--	0.49 J	--	--
Phenanthrene	1170	0.79 J	1.3 J	0.87 J	0.56 J	12	1.3 J	7.65 J	14.3 U	4.8	105 D	15.8 J, D
Anthracene	845	0.32 J	0.51 J	5 U	0.65 J	4.8 J	0.81 J	15.2 U	14.3 U	2.6 J	26.3 D	7.47 U, D
Fluoranthene	2230	1.9 J	2.2 J	1.7 J	1.5 J	35	2.7 J	15.3 D	14.3 U	11	263 D	41.9 D
Pyrene	1520	2.5 J	2.6 J	1.7 J	1.7 J	34	3.8 J	24.7 D	5.56 J, D	14	309 D	40.5 D
Benzo(b)fluoranthene	--	1.4 J	1.4 J	1.4 J	1.8 J	24	1.5 J	18.9 D	14.3 U	7	326 D	59.5 J
Benzo(k)fluoranthene	13000	1.1 J	0.85 J	0.9 J	1.1 J	31	2.7 J	13.9 J, D	14.4 U	12	248 D	33.6 J
Benzo(a)anthracene	1050	1.6 J	0.89 J	1.4 J	1.3 J	15	1.5 J	10.1 J, D	14.4 U	5.5	201 D	31.2 D
Chrysene	1290	1.5 J	1.4 J	1.2 J	1.3 J	28	2.7 J	21.4 D	14.3 U	11	238 D	43.3 D
Benzo(a)pyrene	1450	1.4 J	1.2 J	1.1 J	1.2 J	21	2.6 J	16.9 D	4.86 J, D	6.1	281 D	47.8 J
Indeno(1,2,3-cd)pyrene	100	1.7 J	1.9 J	1.4 J	2 J	28	2.8 J	8.8 J, D	14.4 U	9.5	**121** D	25.3 J
Dibenz(a,h)anthracene	1300	0.37 J	0.3 J	5 U	5 U	5.9	4.9 U	15.2 U	14.4 U	2 J	43.9 D	12 J
Benzo(g,h,i)perylene	300	1.8 J	2.3 J	1.4 J	2.3 J	26	3.5 J	11 J, D	14.3 U	9.7	133 D	28.1 J

Notes:
1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method

detection limit (MDL).
6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID	T4S1SB-94-0-1	T4S1SB-94-0-2	T4S1SB-95-0-1	AOC72-S1-0.5	AOC72-S1-1.5	AOC72-S2-0.5	AOC72-S2-1.5	AOC72-S3-0.5	AOC72-S3-1.5	MW16-0.5-1	T4S1S-10-1
	Drainage Basin	Q	Q	Q	L	L	L	L	L	L	L	K
	Lab ID		K2502049-010								K2402343-006	K2406499-005
	Sample Interval	1 - 3	1 - 3	0.5 - 2.5	0.5 - 1.5	1.5 - 2.5	0.5 - 1.5	1.5 - 2.5	0.5 - 1.5	1.5 - 2.5	0.5 - 1	0 - 0.5
	Sample Date	9/7/2005	9/7/2005	9/7/2005	3/8/2004	3/8/2004	3/8/2004	3/8/2004	3/8/2004	3/8/2004	3/29/2004	8/27/2004
	OU	OU1	OU1	OU1	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2
Compound (Concentrations in µg/kg)	McDonalds PECs											
Naphthalene	561	5.75 J, D	5.49 J, D	12 J, D	1.3 J	4.8 U	0.24 J	4.8 U	4.7 U	0.34 J	3.6 J	19
2-Methylnaphthalene	200	--	--	--	1.1 J	4.8 U	4.7 U	4.8 U	4.7 U	4.8 U	--	5.9
Acenaphthylene	200	3.53 U	14.5 U	11.2 J, D	2 J	4.8 U	0.36 J	4.8 U	4.7 U	0.25 J	3.3 J	10
Acenaphthene	300	3.53 U	14.5 U	34.9 D	0.66 J	4.8 U	4.7 U	4.8 U	4.7 U	4.8 U	0.6 J	2.1 J
Fluorene	536	3.53 U	14.5 U	14.3 D	1.7 J	4.8 U	0.2 J	4.8 U	4.7 U	4.8 U	0.56 J	1.9 J
Dibenzofuran	--	--	--	--	0.79 J	4.8 U	4.7 U	4.8 U	4.7 U	4.8 U	--	1.5 J
Phenanthrene	1170	17.4 D	15.3 D	212 D	6.6	1.3 J	1.5 J	1.1 J	1.2 J	0.25 J	9.5	52
Anthracene	845	4.92 J, D	4.47 J, D	41.7 D	2.9 J	0.63 J	1.4 J	0.75 J	0.62 J	0.33 J	3.2 J	13
Fluoranthene	2230	34.8 D	26.7 D	520 D	7.9	1.2 J	2.7 J	0.98 J	1.1 J	0.44 J	30	270
Pyrene	1520	37.5 D	37.9 D	650 D	11	1.2 J	2.9 J	0.91 J	1.1 J	0.55 J	41	380
Benzo(b)fluoranthene	--	40.6 J	31.2 D	644 D	3.7 J	0.16 J	2.3 J	4.8 U	4.7 U	0.42 J	26	200
Benzo(k)fluoranthene	13000	24.9 J	20.3 D	480 D	5.3	0.19 J	1.5 J	0.18 J	0.22 J	0.4 J	25	170
Benzo(a)anthracene	1050	19.8 D	14.5 D	383 D	4.2 J	0.45 J	1.3 J	U	0.22 J	0.21 J	17	180
Chrysene	1290	34.8 D	26.7 D	474 D	6.3	0.38 J	1.9 J	0.21 J	0.31 J	0.41 J	25	250
Benzo(a)pyrene	1450	32.1 J	24.4 D	568 D	4.5 J	0.26 J	0.77 J	0.23 J	0.23 J	0.19 J	37	270
Indeno(1,2,3-cd)pyrene	100	25.8 J	14.2 J, D	**242** D	3.7 J	4.8 U	0.9 J	4.8 U	4.7 U	0.28 J	51	**240**
Dibenz(a,h)anthracene	1300	7.03 J, D	4.1 J, D	84.7 D	0.44 J	4.8 U	4.7 U	4.8 U	4.7 U	4.8 U	7.4	35
Benzo(g,h,i)perylene	300	34.1 J	18.1 D	258 D	4.9 J	0.15 J	1.1 J	0.21 J	4.7 U	0.49 J	64	270

Notes:

1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method detection limit (MDL).
6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID Drainage Basin Lab ID Sample Interval Sample Date OU	T4S1S-14B M K2502049-011 0.5 - 1 9/8/2005 OU2	T4S1S-8-1 L K2406499-007 0 - 0.5 8/27/2004 OU2	T4S1S-9-1 L K2406499-006 0 - 0.5 8/27/2004 OU2	T4S1SB-53-1-1 L K2406534-003 0.5 - 1 8/27/2004 OU2	T4S1SB-55-1-1 M K2406589-004 1 - 2 8/27/2004 OU2	T4S1SB-58-1-1 M K2406589-007 1 - 2 8/31/2004 OU2	T4S1SB-70-1-1 L K2406457-008 1 - 2 8/26/2004 OU2	T4S1SB-71-1-1 L K2406457-007 1 - 2 8/26/2004 OU2	T4S1SB-72-1-1 L K2406457-006 1 - 2 8/26/2004 OU2	T4S1SB-73-1-1 L K2406457-004 0.5 - 1.5 8/26/2004 OU2	T4S1SB-74-1-1 L K2406457-003 1 - 2 8/26/2004 OU2
Compound (Concentrations in µg/kg)	McDonalds PECs											
Naphthalene	561	14.1 U	1.9 J	6.5	3.2 J	1.9 J	0.98 J	330 U	330 U	330 U	330 U	340 U
2-Methylnaphthalene	200	--	0.7 J	2.1 J	1.5 J	1 J	0.5 J	330 U	330 U	330 U	330 U	340 U
Acenaphthylene	200	14.1 U	1.3 J	6	1.5 J	0.47 J	4.3 U	330 U	330 U	330 U	330 U	340 U
Acenaphthene	300	27.4 D	0.21 J	0.7 J	0.28 J	4.4 U	4.3 U	330 U	330 U	330 U	330 U	340 U
Fluorene	536	12.5 J, D	0.31 J	1.1 J	0.8 J	0.3 J	0.21 J	330 U	330 U	330 U	330 U	340 U
Dibenzofuran	--	347 U	0.35 J	0.88 J	0.54 J	0.38 J	0.25 J	330 U	330 U	330 U	330 U	340 U
Phenanthrene	1170	183 D	1.9 J	14	5.2	3.9 J	0.74 J	330 U	330 U	330 U	330 U	340 U
Anthracene	845	30.9 D	1 J	5.6	2.4 J	0.59 J	4.3 U	330 U	330 U	330 U	330 U	340 U
Fluoranthene	2230	483 D	7.3	38	11	4.6	0.81 J	39 J	330 U	330 U	22 J	340 U
Pyrene	1520	437 D	10	54	15	4.7	0.93 J	34 J	330 U	330 U	19 J	340 U
Benzo(b)fluoranthene	--	476 D	7.7	40	5.7	3.1 J	1.2 J	30 J	330 U	330 U	330 U	340 U
Benzo(k)fluoranthene	13000	438 D	6.4	37	8.8	2.2 J	0.81 J	330 U	330 U	330 U	330 U	340 U
Benzo(a)anthracene	1050	315 D	5.8	26	4.5 J	2.6 J	0.41 J	22 J	330 U	330 U	330 U	340 U
Chrysene	1290	388 D	7	36	9.3	4.2 J	1.3 J	30 J	330 U	330 U	14 J	340 U
Benzo(a)pyrene	1450	455 D	10	55	8	2.1 J	0.7 J	26 J	330 U	330 U	330 U	340 U
Indeno(1,2,3-cd)pyrene	100	**209** D	10	63	9.2	2.3 J	1.1 J	330 U	330 U	330 U	330 U	340 U
Dibenz(a,h)anthracene	1300	76.9 D	1.5 J	7.9	1.5 J	0.47 J	0.35 J	330 U	330 U	330 U	330 U	340 U
Benzo(g,h,i)perylene	300	210 D	13	79	11	2.6 J	1.4 J	34 J	330 U	330 U	330 U	340 U

Notes:
1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method

detection limit (MDL). 6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1A - PAHs in Surface Soil
Terminal 4 Slip 1 Upland Facility

	Sample ID	T4S1SB-75-1-1	T4S1SB-76-1-1	T4S1SB-77-1-1	T4S1SB-78-1-1	T4S1SB-79-3-1	T4S1SB-80-3-1	T4S1SB-81-3-1
	Drainage Basin	L	L	N	N	N	N	N
	Lab ID	K2406457-002	K2406457-001	K2406532-001	K2406532-003	K2406589-001	K2406532-005	K2406532-006
	Sample Interval	1 - 2	1 - 2	0.5 - 1	0.5 - 1.5	2.5 - 3.5	2.5 - 3.5	2.5 - 3.5
	Sample Date	8/26/2004	8/26/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004
	OU	OU2	OU2	OU2	OU2	OU2	OU2	OU2
Compound (Concentrations in µg/kg)	McDonalds PECs							
Naphthalene	561	120 J	330 U	330 U	330 U	5	1.3 J	0.84 J
2-Methylnaphthalene	200	93 J	330 U	330 U	330 U	6.6	0.58 J	5 U
Acenaphthylene	200	22 J	330 U	330 U	330 U	0.78 J	5 U	5 U
Acenaphthene	300	330 U	330 U	330 U	330 U	0.46 J	5 U	5 U
Fluorene	536	330 U	330 U	330 U	330 U	0.57 J	5 U	5 U
Dibenzofuran	--	43 J	330 U	330 U	330 U	2.3 J	0.22 J	5 U
Phenanthrene	1170	150 J	16 J	14 J	330 U	11	5 U	5 U
Anthracene	845	46 J	330 U	330 U	330 U	0.92 J	5 U	5 U
Fluoranthene	2230	250 J	36 J	19 J	18 J	9.1	0.44 J	0.39 J
Pyrene	1520	200 J	31 J	330 U	17 J	11	0.4 J	5 U
Benzo(b)fluoranthene	--	190 J	22 J	330 U	330 U	5.8	0.54 J	5 U
Benzo(k)fluoranthene	13000	150 J	330 U	330 U	330 U	5.3	5 U	5 U
Benzo(a)anthracene	1050	120 J	19 J	330 U	330 U	5.5	0.27 J	5 U
Chrysene	1290	240 J	25 J	330 U	330 U	8.3	5 U	5 U
Benzo(a)pyrene	1450	150 J	330 U	330 U	330 U	6.6	0.26 J	5 U
Indeno(1,2,3-cd)pyrene	100	170 J	330 U	330 U	330 U	6.2	0.28 J	5 U
Dibenz(a,h)anthracene	1300	38 J	330 U	330 U	330 U	1.1 J	5 U	5 U
Benzo(g,h,i)perylene	300	190 J	33 J	330 U	330 U	7.4	0.31 J	5 U

Notes:
1. PAHs = Polynuclear Aromatic Hydrocarbons by EPA Method 8270C (SIM).
2. µg/kg = Micrograms per kilogram.
3. PEC = Probable Effect Concentration, values taken from Portland Harbor Joint Source Control Strategy, Final - Dec. 2005
4. -- = No screening level available or not analyzed.
5. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method

detection limit (MDL).
6. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
7. D = Dilution.
8. **Bold** values indicate that the detected concentration exceeds the PEC.
9. Sample ID nomenclature is per the following: type of sample-sample number-depth in feet-designation.

For example T4S1SB-46-1-1 = soil boring (SB) number 46, collected 1 foot below the ground surface, primary sample (1).
Soil sample number 6 = T4S1S-6 = surface

Table 1B - PAHs and TPH in Surface Soil Samples
Terminal 4 Slip 3 Remedial Investigation

	Lab ID Sample ID Drainage Basin Sampling Date Depth in Feet	K9909106-001 HC-SS-01 D 12/16/99 1-2	K9909106-002 HC-SS-02 D 12/16/99 2-3	K9909106-003 HC-SS-03 D 12/16/99 2-3	K9909106-004 HC-SS-04 J 12/16/99 0-1	K9909106-005 HC-SS-05 K 12/16/99 1-2	K9909106-006 HC-SS-06 D 12/16/99 0-1	K9909106-007 HC-SS-07 D 12/16/99 1-2	K9909106-008 HC-SS-08 D 12/16/99 1-2	K9909106-008 HC-SS-08 (dup) D 12/16/99 1-2
PAHs in mg/kg	PECs (McDonalds et al)									
2-Methylnaphthalene	0.2	0.02	0.005 U	0.021	0.024	0.008	**500** J	**2**	0.02	0.005 U
Acenaphthene	0.3	0.005 U	0.005 U	0.005 U	0.25	0.005 U	**12** J	0.12	0.005	0.028
Acenaphthylene	0.2	0.007	0.005 U	0.005 U	0.006	0.005 U	0.05 UJ	0.005 U	0.005 U	0.005 U
Anthracene	0.845	0.011	0.005 U	0.016	0.31	0.007	**4.5** J	0.04	0.015	0.035
Fluorene	0.536	0.005 U	0.005 U	0.008	0.1	0.005 U	**19** J	0.15	0.005 U	0.012
Naphthalene	0.561	0.017	0.005 U	0.008	0.033	0.008	**49** J	0.024	0.016	0.005 U
Phenanthrene	1.17	0.03	0.005 U	0.064	**1.3**	0.023	**29** J	0.18	0.054	0.15
Benzo(a)anthracene	1.05	0.099	0.005 U	0.12	**2.2**	0.048	0.26 J	0.013	0.052	0.27
Benzo(a)pyrene	1.45	0.15	0.005 U	0.005 U	**2.9**	0.07	0.05 UJ	0.023	0.067	0.38
Benzo(b)fluoranthene	--	0.1	0.005 U	0.08	2.5	0.048	0.05 UJ	0.024	0.064	0.34
Benzo(k)fluoranthene	13	0.14	0.007	0.026	2.4	0.056	0.26 J	0.023	0.066	0.32
Benzo(g,h,i)perylene	0.3	0.16	0.007	0.047	**1.7**	0.069	0.05 UJ	0.043	0.064	0.28
Chrysene	1.29	0.14	0.006	0.33	**2.3**	0.057	0.43 J	0.028	0.068	0.31
Dibenz(a,h)anthracene	1.3	0.018	0.005 U	0.014	0.35	0.008	0.05 UJ	0.005	0.011	0.06
Fluoranthene	2.23	0.17	0.006	0.052	**2.9**	0.088	1.1 J	0.04	0.11	0.4
Indeno(1,2,3-cd)pyrene	0.1	**0.16**	0.007	0.021	**2.7**	0.073	0.05 UJ	0.041	0.066	**0.35**
Pyrene	1.52	0.23	0.008	0.15	**2.8**	0.11	**1.6** J	0.061	0.1	0.35
Dibenzofuran	--	0.007	0.005 U	0.005 U	0.048	0.005 U	4.9 J	0.005 U	0.009	0.006
TPH[1] in mg/kg										
Diesel Region	--	25 U	25 U	2500	25 U	25 U	430	30000	25 U	
Oil Region	--	50 U	50 U	3800	110	50 U	120	5000 U	84	

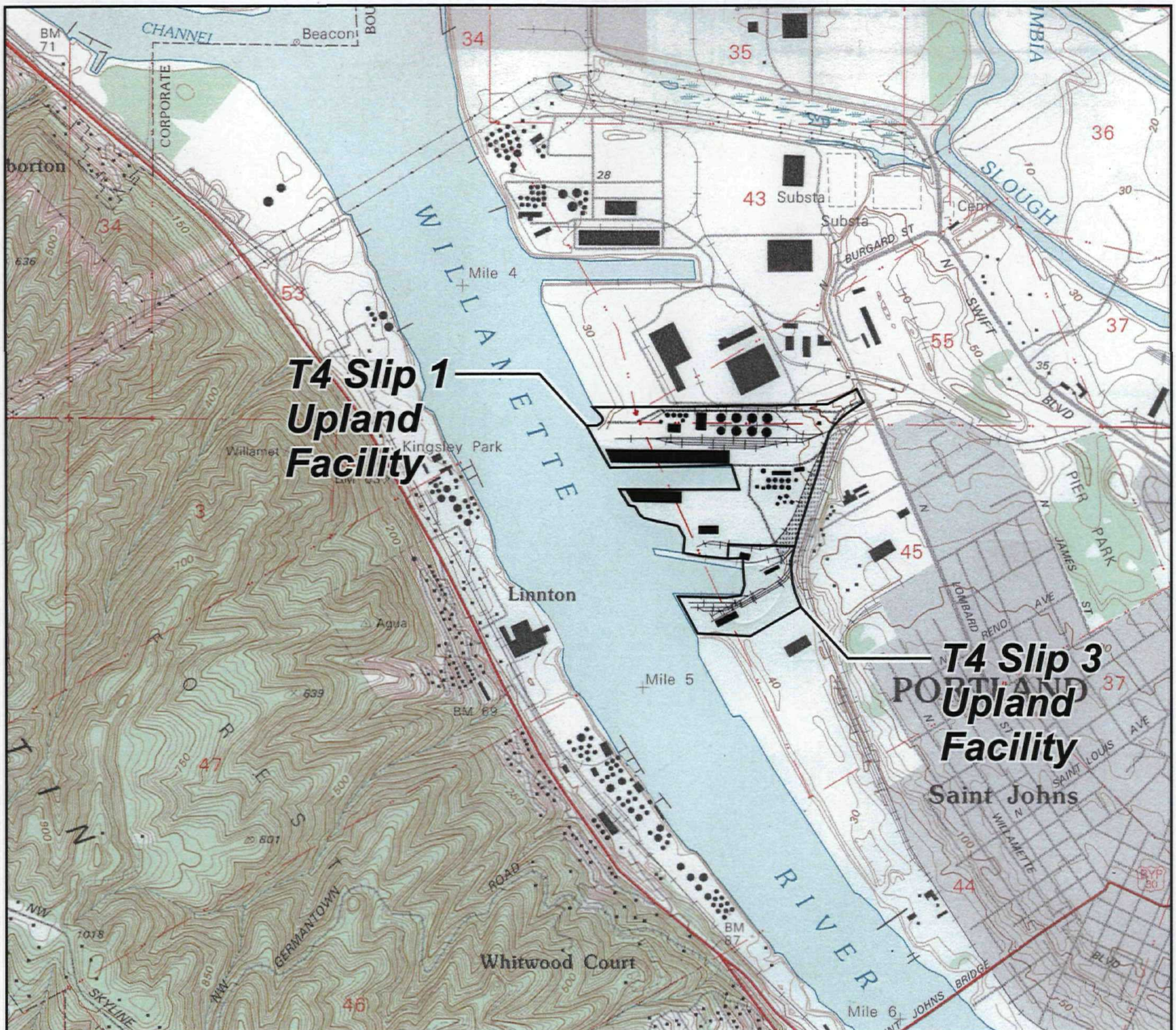
Notes:
1. J = Estimated value.
2. U = Not detected at the indicated sample quantitaion limit.
3. 1 = Area resampled for PAH analyses
4. **Bold** = Exceeds PEC

Table 1C - PAH Concentrations in Surface Soil
Quaker State Tank Farm Area

	Sample ID Depth (ft) Date	Soil #1 0.5 - 3.0 8-Oct-04	Soil #2 0.5 - 3.0 11-Oct-04	Soil #2B 1.5 - 2.0 4-Nov-04	Soil #13 1.0 - 1.5 11-Oct-04	Soil #14 1.0 - 1.5 11-Oct-04	Soil #15 1.0 - 1.5 11-Oct-04	Soil #16 3.0 - 3.5 11-Oct-04	Soil #17 0.0 - 1.0 5-Nov-04	Soil #18 0.0 - 1.0 4-Nov-04	Soil #19 0.0 - 1.0 4-Nov-05	Soil #20 0.0 - 1.0 4-Nov-04	Soil #21 0.0 - 1.0 4-Nov-04	Soil #22 0.0 - 1.0 4-Nov-04	Soil #23 0.0 - 1.0 4-Nov-04	Soil #24 0.0 - 1.0 5-Nov-04	Soil #25 0.0 - 1.0 5-Nov-04
Analyte (Concentrations in µg/kg [ppb])	McDonalds PECs																
Acenaphthene	300	27.9	158	< 67.0	< 67.0	70.3	< 134	16.0	< 335	< 335	< 134	< 134	< 134	< 134	< 134	< 268	< 67.0
Acenaphthylene	200	< 13.4	< 67.0	< 67.0	< 67.0	< 67.0	< 134	< 13.4	< 335	< 335	< 134	< 134	< 134	< 134	< 134	< 268	< 67.0
Anthracene	845	25.5	124	< 67.0	< 67.0	< 67.0	< 134	16.1	< 335	< 335	< 134	< 134	< 134	< 134	< 134	< 268	< 67.0
Benzo(a)anthracene	1,050	267	1,050	138	74.2	532	192	115	624	**1,250**	637	552	648	257	< 134	327	85.7
Benzo(a)pyrene	1,450	348	1,220	238	107	655	194	144	818	**1,580**	876	665	810	305	170	374	108
Benzo(b)fluoranthene	--	344	1,150	179	85.5	638	170	131	760	1,710	854	519	830	359	166	417	112
Benzo(ghi)perylene	300	318	**1,060**	242	132	**603**	251	133	**844**	**1,260**	**744**	**593**	**793**	**301**	**473**	**348**	107
Benzo(k)fluoranthene	13,000	245	913	145	67.4	461	142	102	628	1,130	595	500	581	250	< 134	322	79.5
Chrysene	1,290	322	1,190	188	96.8	616	231	120	695	**1,430**	749	631	763	328	163	382	98.4
Dibenzo(a,h)anthracene	1,300	93.3	333	< 67.0	< 67.0	184	< 134	39.8	< 335	369	169	< 134	201	< 134	< 134	< 268	< 67.0
Fluoranthene	2,230	401	1,800	229	124	866	321	158	934	1,910	1,020	957	1,110	415	190	513	126
Fluorene	536	14.5	77.8	< 67.0	< 67.0	< 67.0	< 134	< 13.4	< 335	< 335	< 134	< 134	< 134	< 134	< 134	< 268	< 67.0
Indeno(1,2,3-cd)pyrene	100	**280**	**968**	**174**	95.2	**537**	**166**	**116**	**590**	**1,080**	**597**	**456**	**632**	**254**	**169**	**301**	84.5
Naphthalene	561	< 13.4	< 67.0	< 67.0	< 67.0	< 67.0	< 134	< 13.4	< 335	< 335	< 134	< 134	< 134	< 134	< 134	< 268	< 67.0
Phenanthrene	1,170	167	776	< 67.0	< 67.0	352	174	68.6	365	761	349	230	484	186	< 134	< 268	< 67.0
Pyrene	1,520	432	1,400	308	144	766	563	153	878	**1,630**	1,080	1,070	981	370	446	449	121

Notes:
1. **Bold** Represents Detected Concentrations Above PEC.
2. < = Not Detected at Associated Method Reporting Limit.
3. RBC = Oregon DEQ Risk Based Concentration (December 17, 2003) - Direct Contact with Soil.
4. PRG = EPA Region IX Preliminary Remediation Goal (October 1, 2002) - Direct Contact with Soil.
5. NA = Not Available.

** The former Quaker State Tank Farm area, while in Basin J, does not drain to any of the catch basins; surface water in this area infiltrates.



Base map prepared from the USGS 7.5-minute quadrangle of Linnton, Oregon, dated 1990.

N

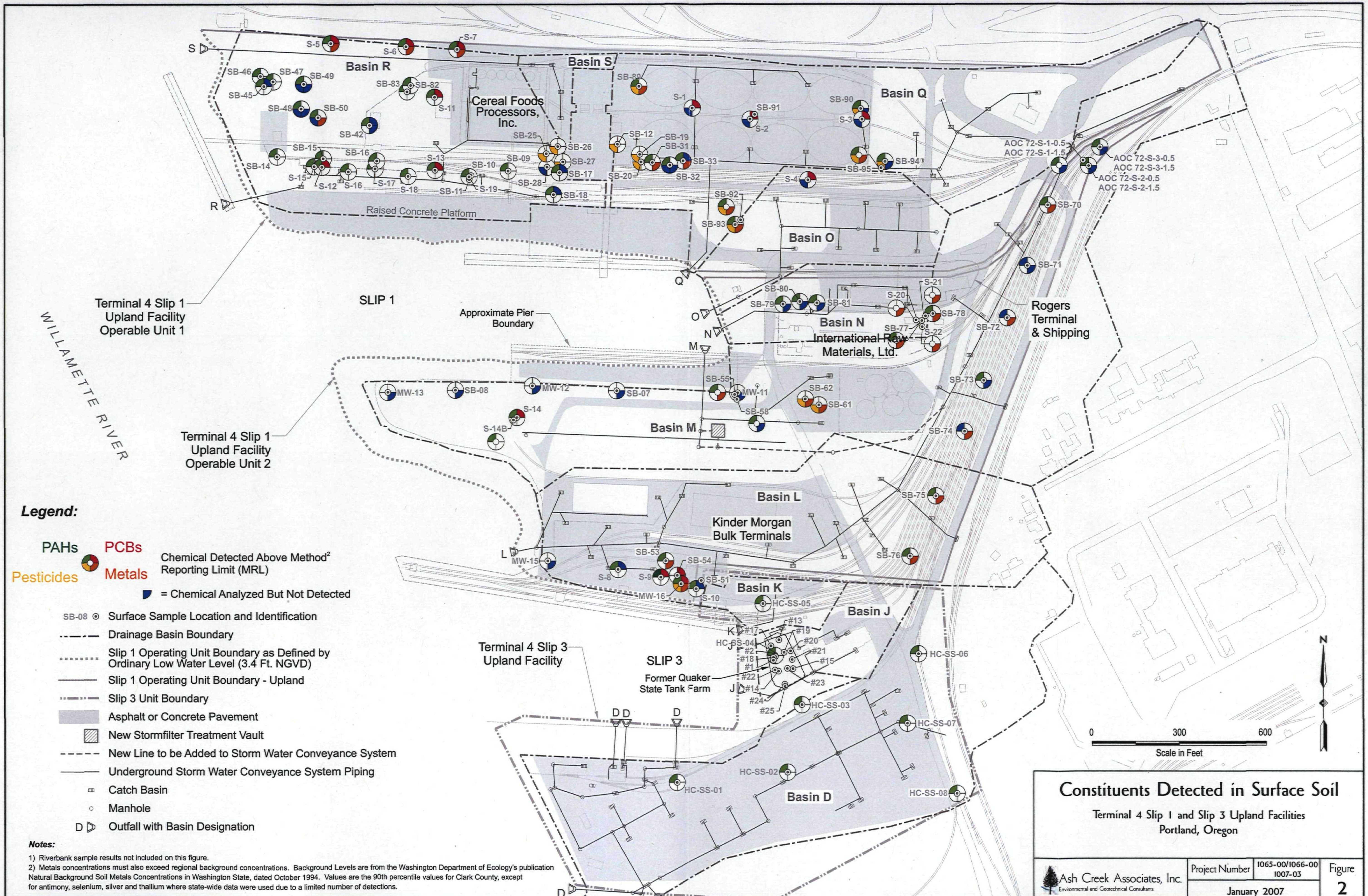
0 2000 4000

Scale in Feet

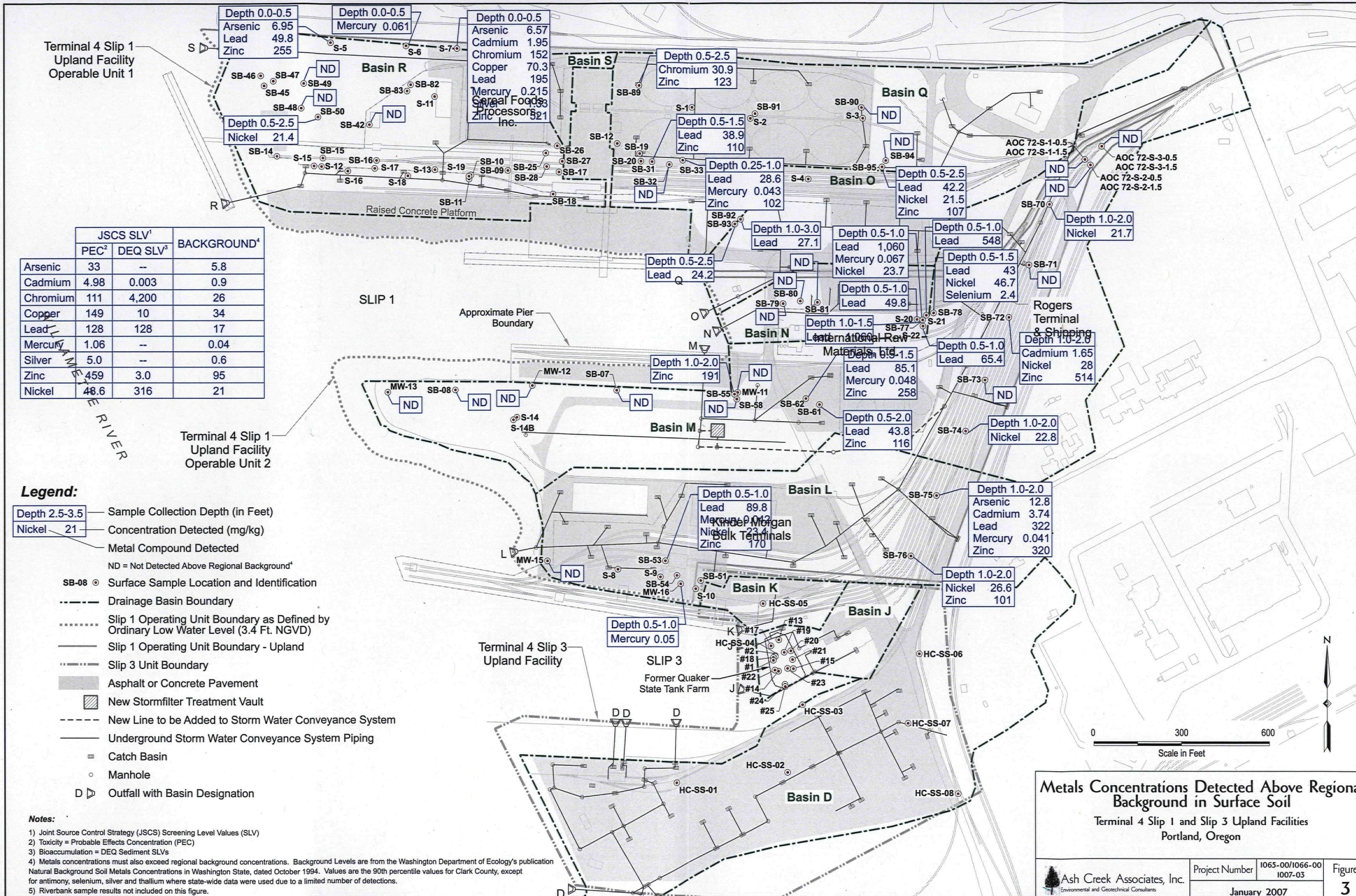
Facility Location Map

Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1065-00/1066-00 1007-03	Figure
	February 2007		1



Constituents Detected in Surface Soil
Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon
Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants
Project Number
1065-00/1066-00
1007-03
January 2007
Figure
2
Basin R
Basin S
Basin Q
Basin O
Basin N
Basin M
Basin L
Basin K
Basin J
Basin D
Cereal Foods Processors, Inc.
International Raw Materials, Ltd.
Kinder Morgan Bulk Terminals
Rogers Terminal & Shipping
Raised Concrete Platform
SLIP 1
SLIP 3
Approximate Pier Boundary
Terminal 4 Slip 1 Upland Facility Operable Unit 1
Terminal 4 Slip 1 Upland Facility Operable Unit 2
Terminal 4 Slip 3 Upland Facility
Former Quaker State Tank Farm
WILLAMETTE RIVER
Legend:
PAHs
PCBs
Pesticides
Metals
Chemical Detected Above Method² Reporting Limit (MRL)
= Chemical Analyzed But Not Detected
SB-08 Surface Sample Location and Identification
Drainage Basin Boundary
Slip 1 Operating Unit Boundary as Defined by Ordinary Low Water Level (3.4 Ft. NGVD)
Slip 1 Operating Unit Boundary - Upland
Slip 3 Unit Boundary
Asphalt or Concrete Pavement
New Stormfilter Treatment Vault
New Line to be Added to Storm Water Conveyance System
Underground Storm Water Conveyance System Piping
Catch Basin
Manhole
D Outfall with Basin Designation
Notes:
1) Riverbank sample results not included on this figure.
2) Metals concentrations must also exceed regional background concentrations. Background Levels are from the Washington Department of Ecology's publication Natural Background Soil Metals Concentrations in Washington State, dated October 1994. Values are the 90th percentile values for Clark County, except for antimony, selenium, silver and thallium where state-wide data were used due to a limited number of detections.
0
300
600
Scale in Feet
N



	JSCS SLV[1]		BACKGROUND[4]
	PEC[2]	DEQ SLV[3]	
Arsenic	33	--	5.8
Cadmium	4.98	0.003	0.9
Chromium	111	4,200	26
Copper	149	10	34
Lead	128	128	17
Mercury	1.06	--	0.04
Silver	5.0	--	0.6
Zinc	459	3.0	95
Nickel	48.6	316	21

Legend:

- Depth 2.5-3.5 — Sample Collection Depth (in Feet)
- Nickel 21 — Concentration Detected (mg/kg); Metal Compound Detected
- ND = Not Detected Above Regional Background[4]
- SB-08 — Surface Sample Location and Identification
- Drainage Basin Boundary
- Slip 1 Operating Unit Boundary as Defined by Ordinary Low Water Level (3.4 Ft. NGVD)
- Slip 1 Operating Unit Boundary - Upland
- Slip 3 Unit Boundary
- Asphalt or Concrete Pavement
- New Stormfilter Treatment Vault
- New Line to be Added to Storm Water Conveyance System
- Underground Storm Water Conveyance System Piping
- Catch Basin
- Manhole
- D — Outfall with Basin Designation

Notes:

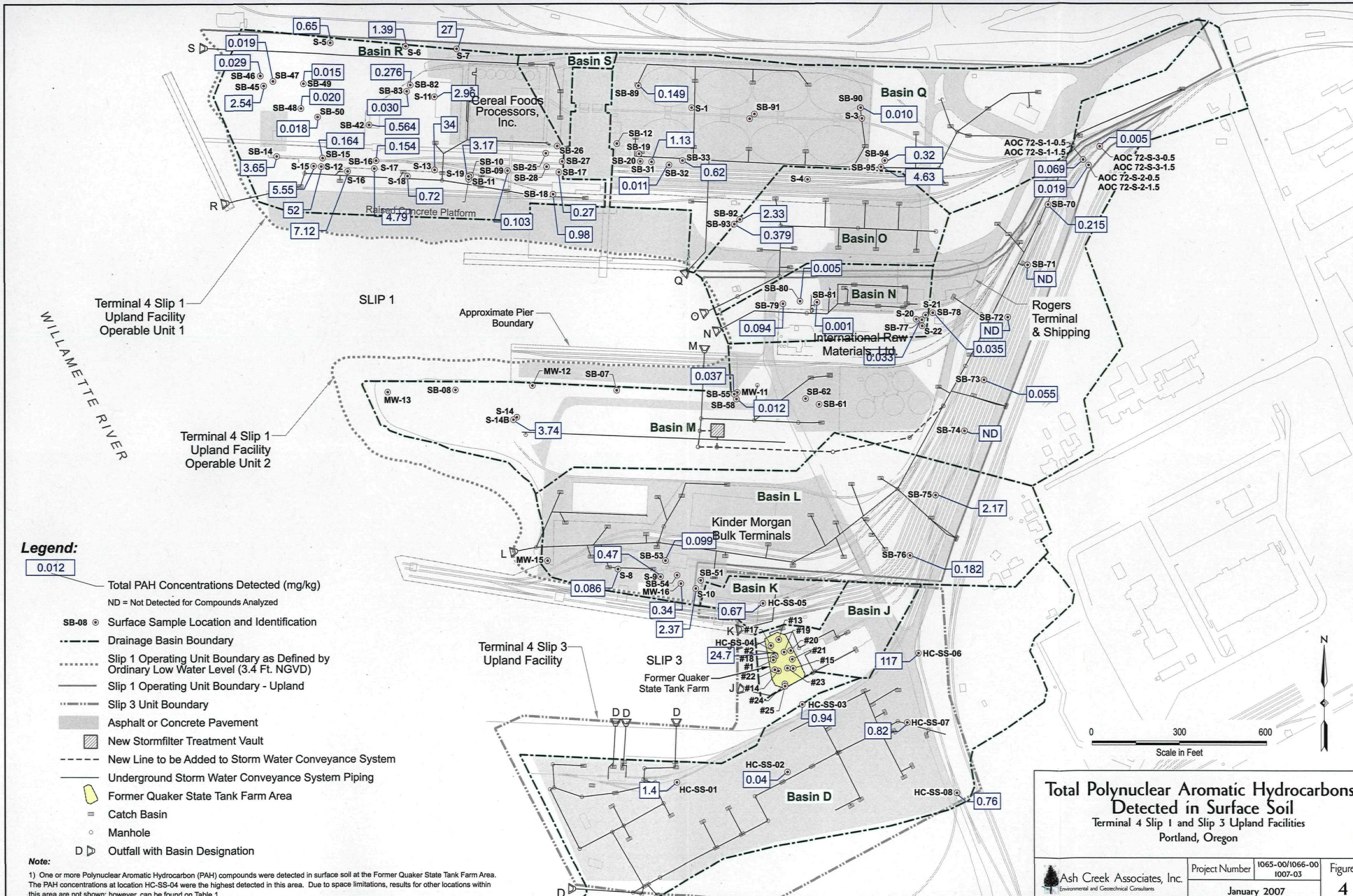
1) Joint Source Control Strategy (JSCS) Screening Level Values (SLV)
2) Toxicity = Probable Effects Concentration (PEC)
3) Bioaccumulation = DEQ Sediment SLVs
4) Metals concentrations must also exceed regional background concentrations. Background Levels are from the Washington Department of Ecology's publication Natural Background Soil Metals Concentrations in Washington State, dated October 1994. Values are the 90th percentile values for Clark County, except for antimony, selenium, silver and thallium where state-wide data were used due to a limited number of detections.
5) Riverbank sample results not included on this figure.

Metals Concentrations Detected Above Regional Background in Surface Soil

Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

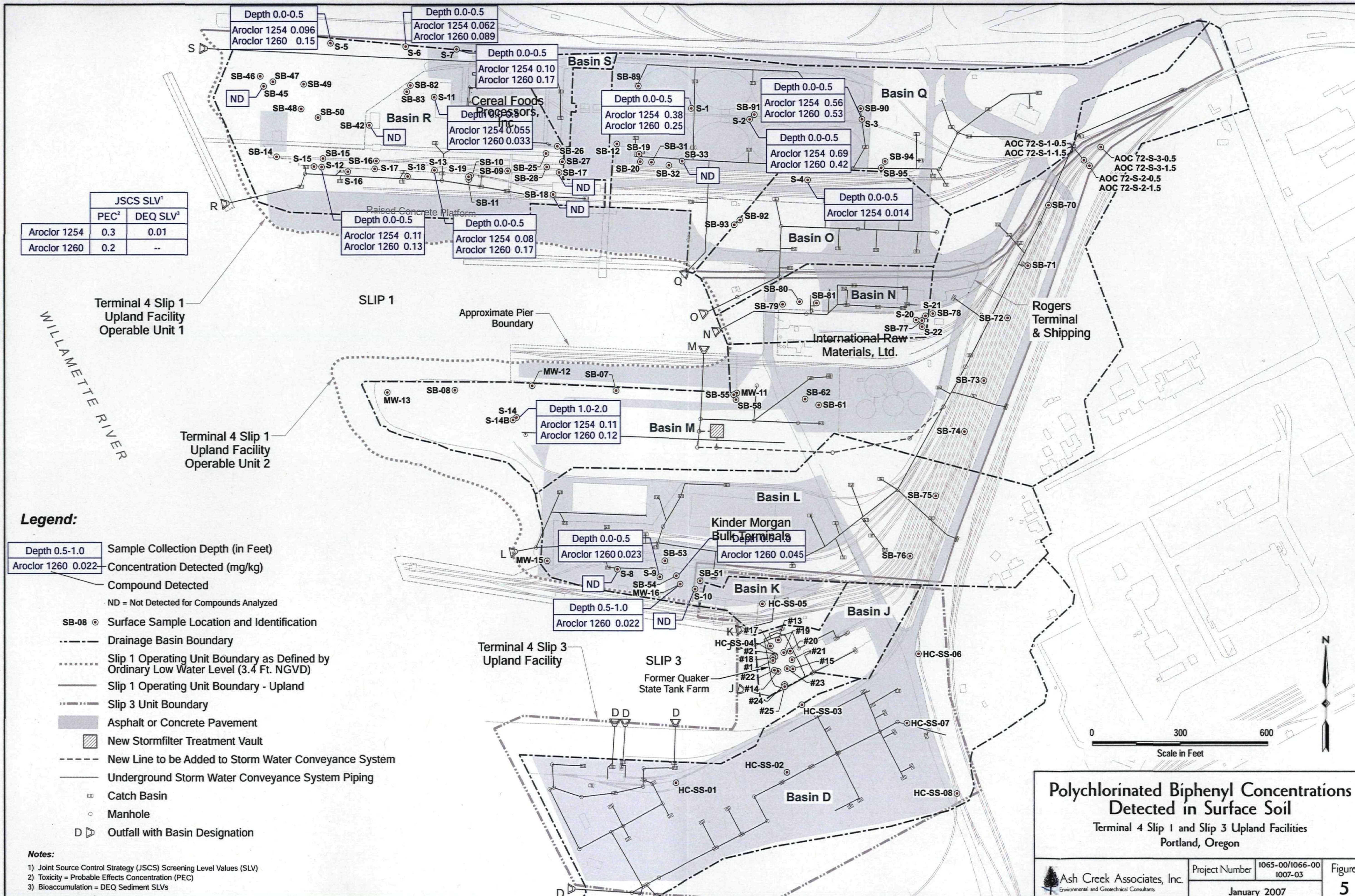
Project Number	1065-00/1066-00 1007-03	Figure
	January 2007	3



Total Polynuclear Aromatic Hydrocarbons Detected in Surface Soil
Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number	1065-00/1066-00 1007-03	Figure
	January 2007	4

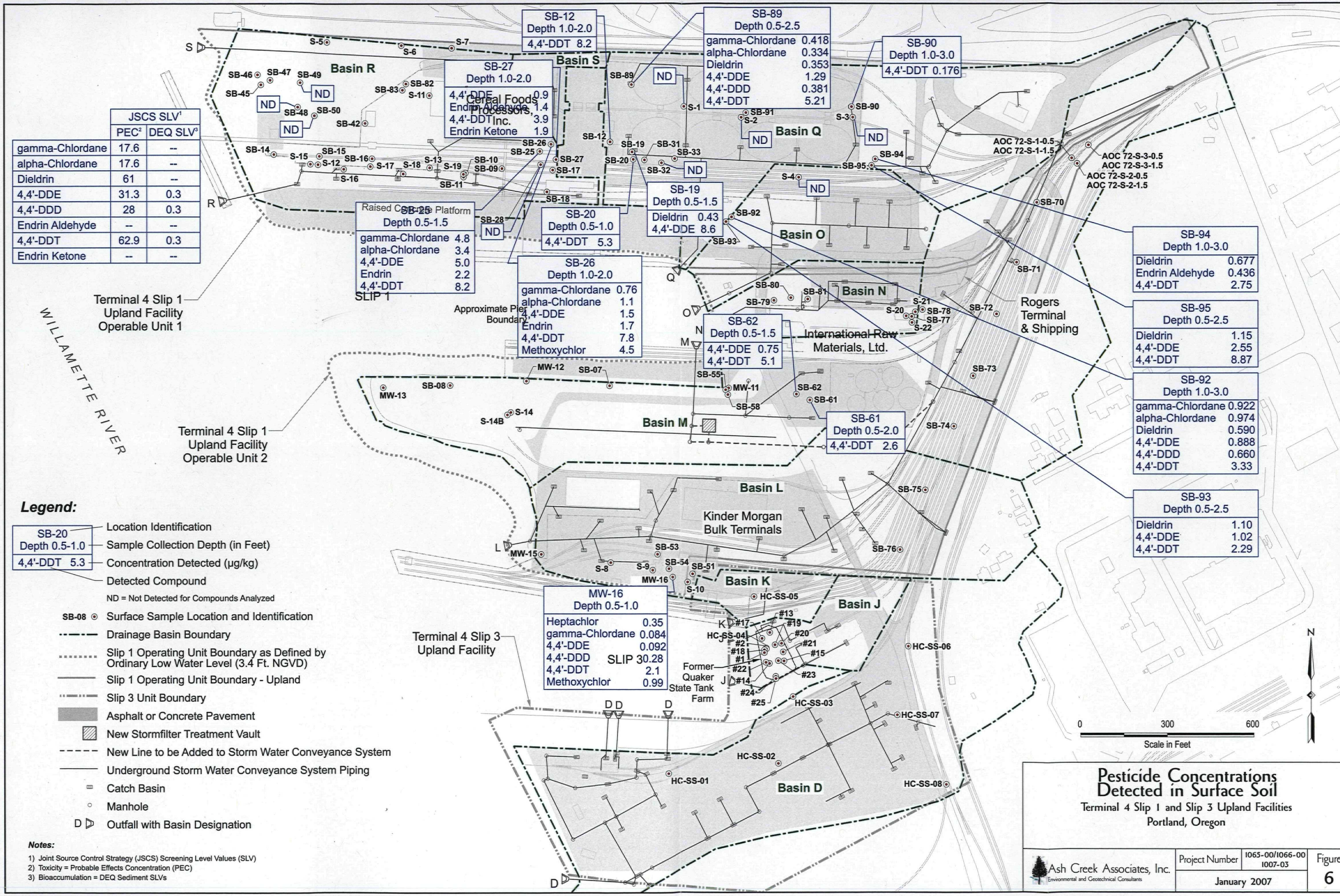


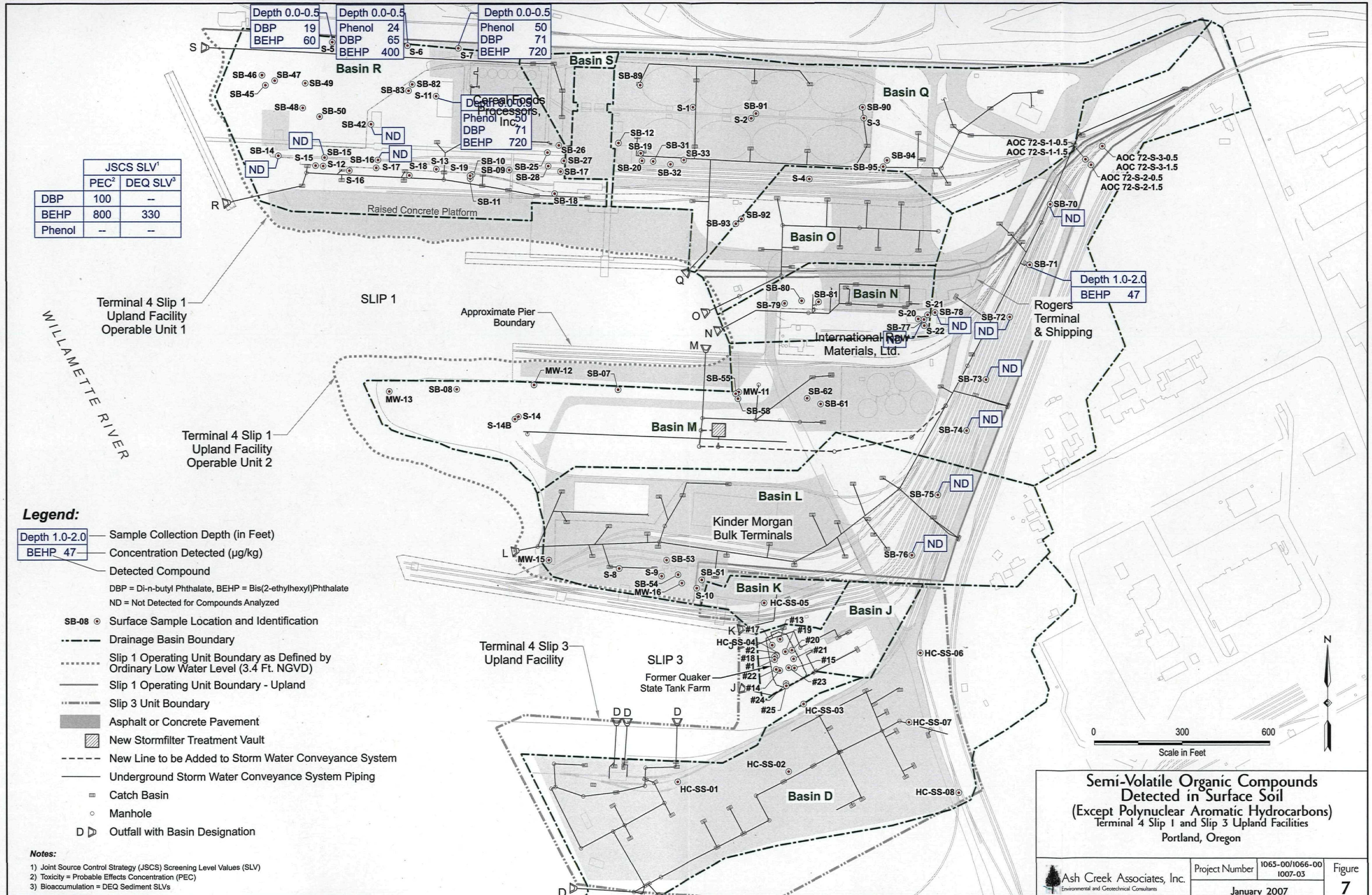
Polychlorinated Biphenyl Concentrations Detected in Surface Soil

Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

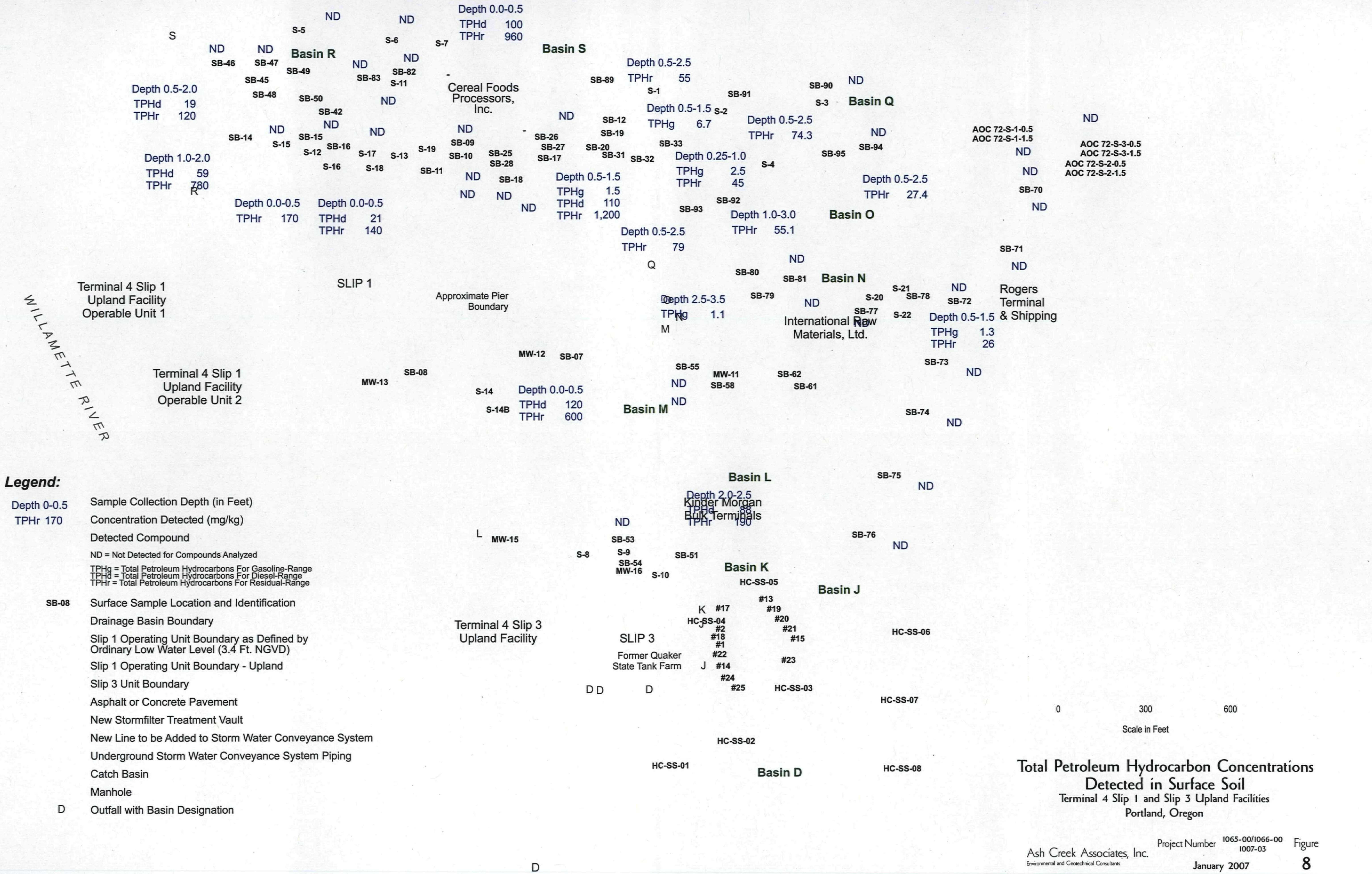
Ash Creek Associates, Inc. Environmental and Geotechnical Consultants

Project Number	1065-00/1066-00 1007-03	Figure
January 2007		5


SB-12
Depth 1.0-2.0
4,4'-DDT 8.2
SB-89
Depth 0.5-2.5
gamma-Chlordane 0.418
alpha-Chlordane 0.334
Dieldrin 0.353
4,4'-DDE 1.29
4,4'-DDD 0.381
4,4'-DDT 5.21
SB-90
Depth 1.0-3.0
4,4'-DDT 0.176
SB-27
Depth 1.0-2.0
4,4'-DDE 0.9
Endrin Aldehyde 1.4
4,4'-DDT 3.9
Endrin Ketone 1.9
Cereal Foods Processors, Inc.
Basin R
Basin S
Basin Q
Basin O
Basin N
Basin M
Basin L
Basin K
Basin J
Basin D
ND
JSCS SLV[1]
PEC[2] DEQ SLV[3]
gamma-Chlordane 17.6 --
alpha-Chlordane 17.6 --
Dieldrin 61 --
4,4'-DDE 31.3 0.3
4,4'-DDD 28 0.3
Endrin Aldehyde -- --
4,4'-DDT 62.9 0.3
Endrin Ketone -- --
SB-25
Raised Concrete Platform
Depth 0.5-1.5
gamma-Chlordane 4.8
alpha-Chlordane 3.4
4,4'-DDE 5.0
Endrin 2.2
4,4'-DDT 8.2
SLIP 1
SB-20
Depth 0.5-1.0
4,4'-DDT 5.3
SB-19
Depth 0.5-1.5
Dieldrin 0.43
4,4'-DDE 8.6
SB-26
Depth 1.0-2.0
gamma-Chlordane 0.76
alpha-Chlordane 1.1
4,4'-DDE 1.5
Endrin 1.7
4,4'-DDT 7.8
Methoxychlor 4.5
Approximate Pier Boundary
SB-62
Depth 0.5-1.5
4,4'-DDE 0.75
4,4'-DDT 5.1
International Raw Materials, Ltd.
Rogers Terminal & Shipping
AOC 72-S-1-0.5
AOC 72-S-1-1.5
AOC 72-S-3-0.5
AOC 72-S-3-1.5
AOC 72-S-2-0.5
AOC 72-S-2-1.5
SB-94
Depth 1.0-3.0
Dieldrin 0.677
Endrin Aldehyde 0.436
4,4'-DDT 2.75
SB-95
Depth 0.5-2.5
Dieldrin 1.15
4,4'-DDE 2.55
4,4'-DDT 8.87
SB-92
Depth 1.0-3.0
gamma-Chlordane 0.922
alpha-Chlordane 0.974
Dieldrin 0.590
4,4'-DDE 0.888
4,4'-DDD 0.660
4,4'-DDT 3.33
SB-93
Depth 0.5-2.5
Dieldrin 1.10
4,4'-DDE 1.02
4,4'-DDT 2.29
SB-61
Depth 0.5-2.0
4,4'-DDT 2.6
Terminal 4 Slip 1 Upland Facility Operable Unit 1
Terminal 4 Slip 1 Upland Facility Operable Unit 2
WILLAMETTE RIVER
Kinder Morgan Bulk Terminals
MW-16
Depth 0.5-1.0
Heptachlor 0.35
gamma-Chlordane 0.084
4,4'-DDE 0.092
4,4'-DDD 0.28
4,4'-DDT 2.1
Methoxychlor 0.99
SLIP 3
Terminal 4 Slip 3 Upland Facility
Former Quaker State Tank Farm
Legend:
SB-20 Location Identification
Depth 0.5-1.0 Sample Collection Depth (in Feet)
4,4'-DDT 5.3 Concentration Detected (µg/kg)
Detected Compound
ND = Not Detected for Compounds Analyzed
SB-08 Surface Sample Location and Identification
Drainage Basin Boundary
Slip 1 Operating Unit Boundary as Defined by Ordinary Low Water Level (3.4 Ft. NGVD)
Slip 1 Operating Unit Boundary - Upland
Slip 3 Unit Boundary
Asphalt or Concrete Pavement
New Stormfilter Treatment Vault
New Line to be Added to Storm Water Conveyance System
Underground Storm Water Conveyance System Piping
Catch Basin
Manhole
D Outfall with Basin Designation
Notes:
1) Joint Source Control Strategy (JSCS) Screening Level Values (SLV)
2) Toxicity = Probable Effects Concentration (PEC)
3) Bioaccumulation = DEQ Sediment SLVs
N
0 300 600
Scale in Feet
Pesticide Concentrations Detected in Surface Soil
Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon
Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants
Project Number 1065-00/1066-00 1007-03
January 2007
Figure 6



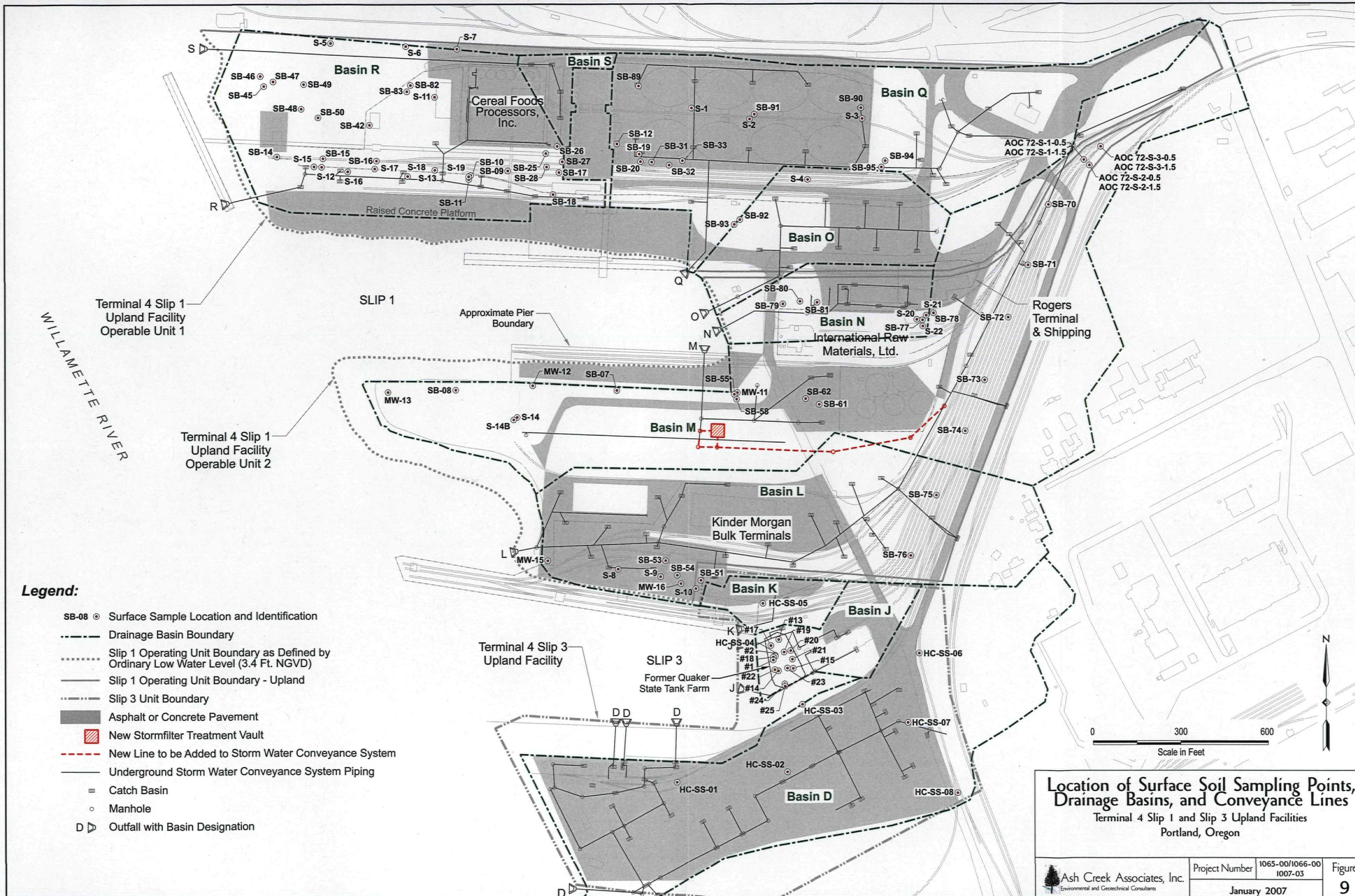
	JSCS SLV[1]	
	PEC[2]	DEQ SLV[3]
DBP	100	--
BEHP	800	330
Phenol	--	--



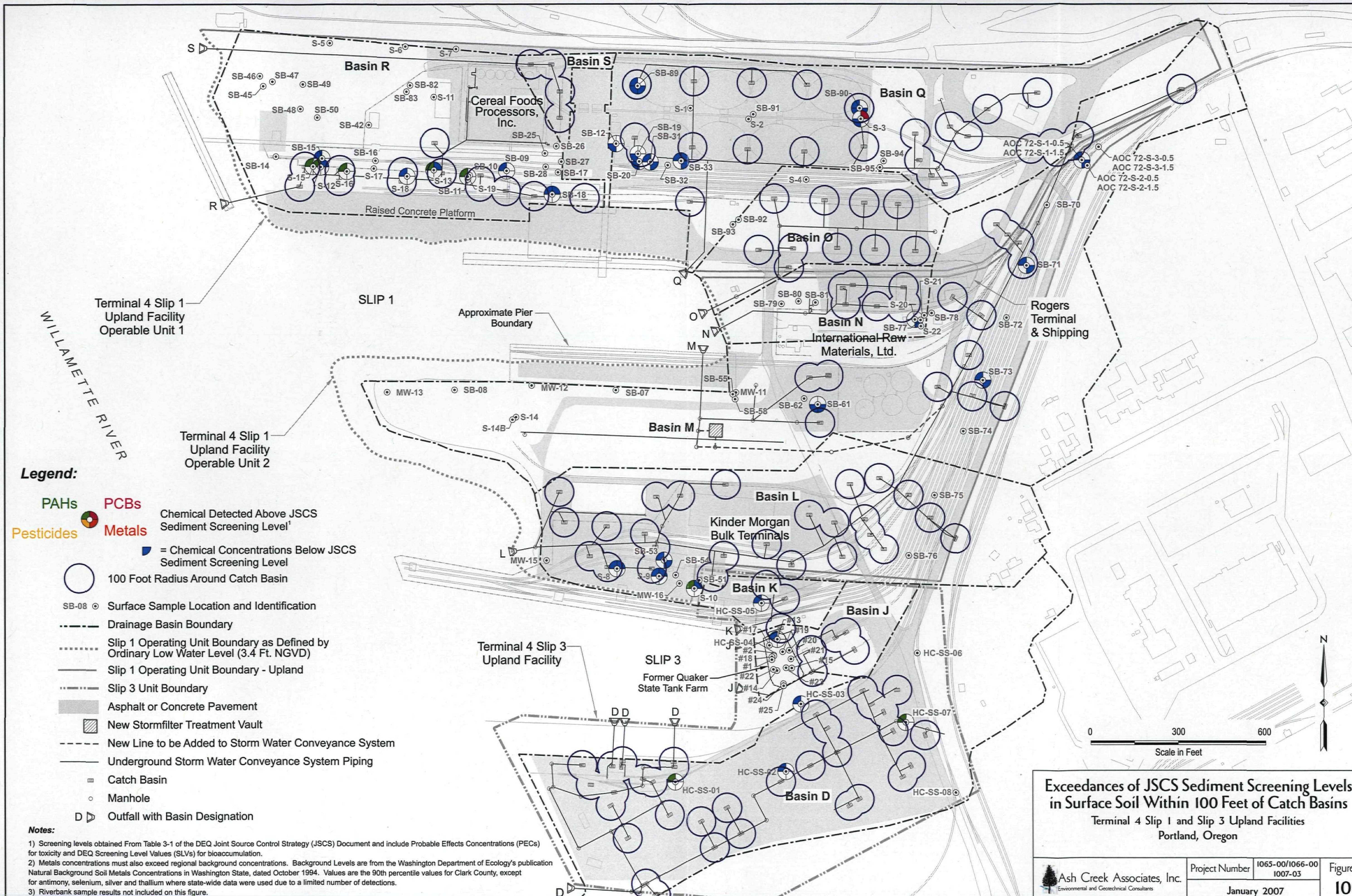
Total Petroleum Hydrocarbon Concentrations Detected in Surface Soil
Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number 1065-00/1066-00 1007-03
January 2007
Figure 8



Location of Surface Soil Sampling Points, Drainage Basins, and Conveyance Lines
Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon



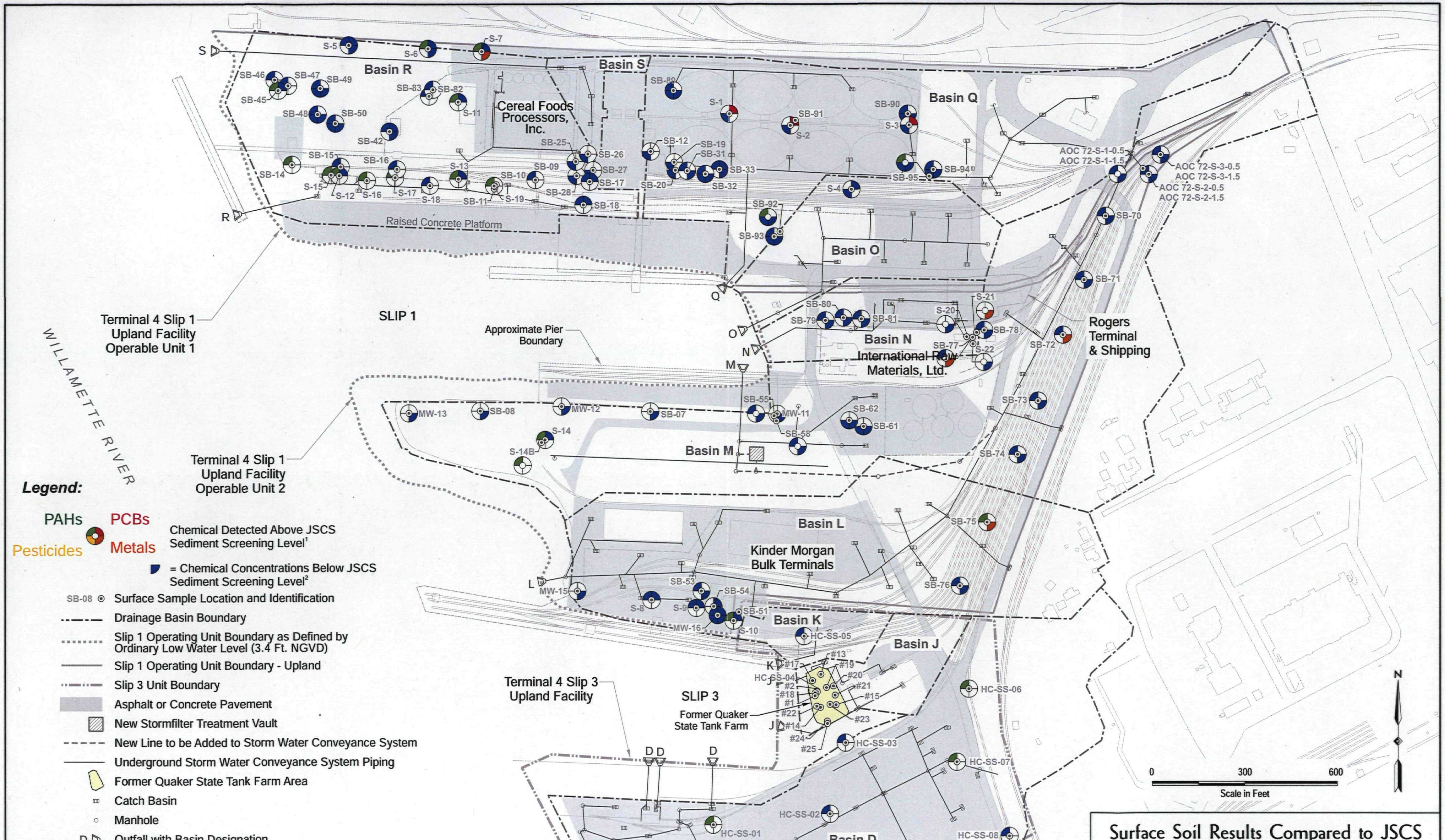
Notes:

1) Screening levels obtained From Table 3-1 of the DEQ Joint Source Control Strategy (JSCS) Document and include Probable Effects Concentrations (PECs) for toxicity and DEQ Screening Level Values (SLVs) for bioaccumulation.
2) Metals concentrations must also exceed regional background concentrations. Background Levels are from the Washington Department of Ecology's publication Natural Background Soil Metals Concentrations in Washington State, dated October 1994. Values are the 90th percentile values for Clark County, except for antimony, selenium, silver and thallium where state-wide data were used due to a limited number of detections.
3) Riverbank sample results not included on this figure.

Exceedances of JSCS Sediment Screening Levels in Surface Soil Within 100 Feet of Catch Basins

Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1065-00/1066-00 1007-03	Figure
	January 2007		10



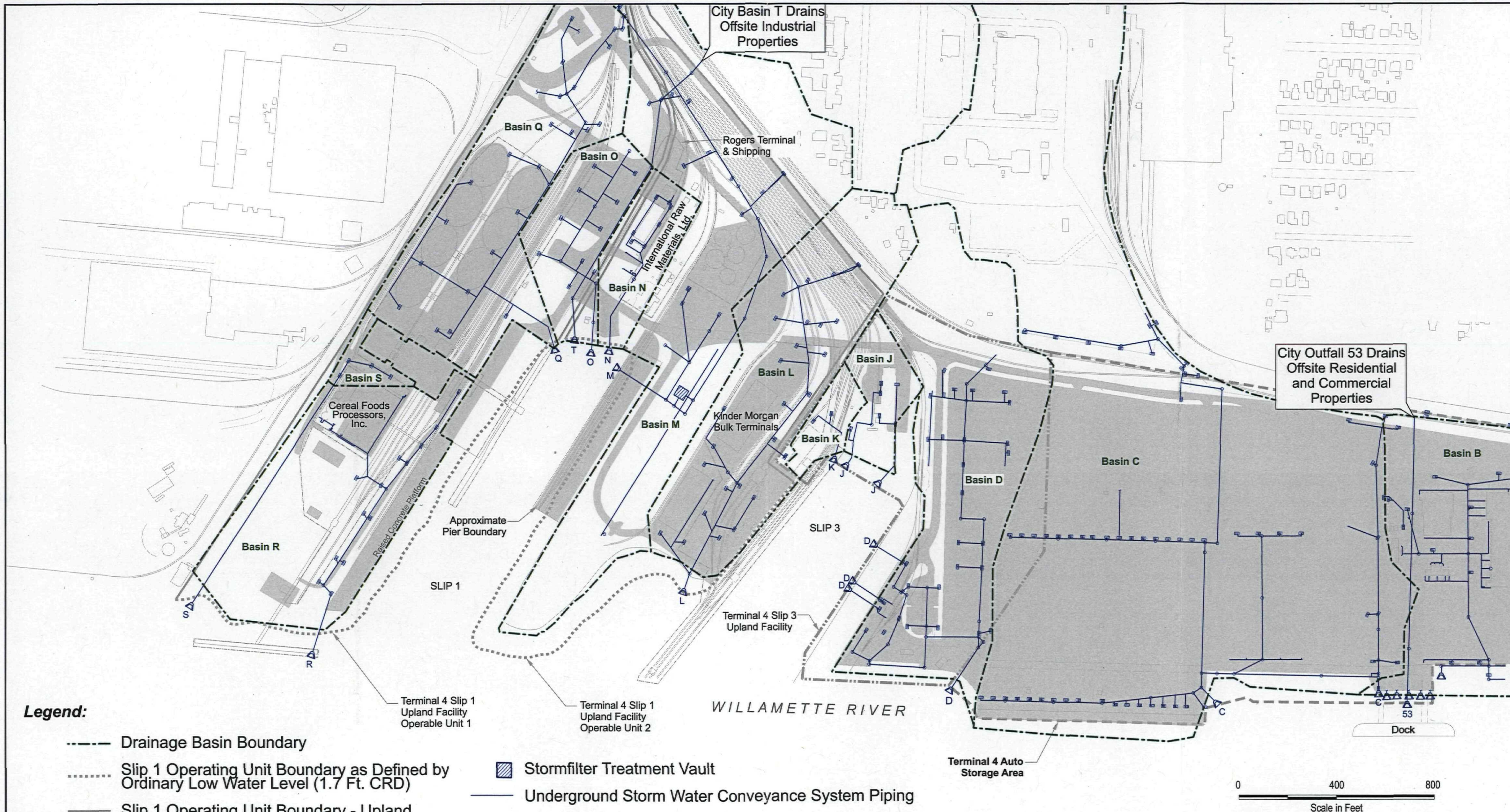
Notes:

1) Screening levels obtained From Table 3-1 of the DEQ Joint Source Control Strategy (JSCS) Document.
2) Metals concentrations must also exceed regional background concentrations. Background Levels are from the Washington Department of Ecology's publication Natural Background Soil Metals Concentrations in Washington State, dated October 1994. Values are the 90th percentile values for Clark County, except for antimony, selenium, silver and thallium where state-wide data were used due to a limited number of detections.
3) Riverbank sample results not included on this figure.
4) One or more Polynuclear Aromatic Hydrocarbon (PAH) compounds were detected in surface soil at the Former Quaker State Tank Farm Area. The PAH concentrations at location HC-SS-04 were the highest detected in this area. Detected PAHs do not exceed JSCS screening levels at all locations within this area. Refer to table C-1 for a summary of the data.

Surface Soil Results Compared to JSCS Sediment Screening Levels

Terminal 4 Slip 1 and Slip 3 Upland Facilities
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1065-00/1066-00 1007-03	Figure
	January 2007		11



Legend:

- Drainage Basin Boundary
- Slip 1 Operating Unit Boundary as Defined by Ordinary Low Water Level (1.7 Ft. CRD)
- Slip 1 Operating Unit Boundary - Upland
- Slip 3 Unit Boundary
- Terminal 4 Auto Storage Area
- Asphalt or Concrete Pavement
- Stormfilter Treatment Vault
- Underground Storm Water Conveyance System Piping
- Catch Basin
- Manhole
- D Outfall with Basin Designation

Notes: 1) Base map prepared from the URS Draft T4 Slip 1 RI Work Plan, dated May 2004.
2) Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3) City outfall 52-C not shown.

Storm Drain System and Drainage Basins

Field Sampling and Procedures Report
Terminal 4 Upland Facility
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1267-05	Figure
	April 2008		3

APPENDIX C

RECLASSIFICATION ANALYSIS BACKGROUND INFORMATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

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Portland Harbor RI/FS Stormwater Loading Calculation Methods Report Appendix C Reclassification Analysis Record January 31, 2011

APPENDIX D
STORMWATER WORKING DATABASE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WA 98101

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